CENTURION UNIVERSITY OF TECHNOLOGY AND MANAGEMENT, ODISHA

SCHOOL OF PARAMEDICS AND ALLIED HEALTH SCIENCES

MASTER OF SCIENCE IN MEDICAL LABORATORY TECHNOLOGY

(TWO YEARS PROGRAMME)

2024

SYLLABUS

M.Sc. in Medical Laboratory Technology

Preface: Medical Laboratory Technology, is an allied health profession dedicated to diagnosing and preventing diseases through clinical laboratory tests. These tests enable doctors to detect, diagnose, and treat various medical conditions.

Medical Laboratory Technologists (MLTs), perform these tests by analyzing body fluids, tissues, blood types, microorganisms, chemical components, and cell counts. They play a critical role in collecting, testing, documenting, and reporting vital information, helping to determine the presence, extent, or absence of diseases and assessing the effectiveness of treatments.

The M.Sc. in Medical Laboratory Technology is a four-semester program that offers comprehensive knowledge and practical applications in fields such as General and Clinical Biochemistry, Hematology, Clinical Pathology, Histopathology & Cytopathology, Immunology, Medical and Diagnostic Microbiology, Genetics, and Molecular Cell Biology over three semesters.

The fourth semester of the M.Sc. in Medical Laboratory Technology program focuses entirely on an internship and a research project, culminating in a dissertation. This field offers vast career opportunities in areas such as diagnostics, research and development, project management, analysis and testing, laboratory services, academics, and international placements.

Medical Laboratory Scientists are generally skilled across all areas of clinical laboratory work. However, some choose to specialize through advanced education or additional training, enabling them to perform more complex analysis within specific domains. These specialties include clinical biochemistry, hematology, coagulation, microbiology, bacteriology, virology, parasitology, mycology, immunology, immunohematology (blood banking), histopathology, cytopathology, genetics, and cytogenetics.

Scope: Upon completing the course, post-graduates can pursue diverse career opportunities, including:

- Working as Clinical Technologists or Lab Managers in hospitals and private laboratories.
- Joining research and development laboratories as Research Scholars or Scientists.
- Serving as Research Assistants or Fellows in biotechnology industries.
- Practicing as Medical Laboratory Scientists in international hospitals and laboratories.

- Taking roles as Senior Technologists in ISO and NABL-certified laboratories.
- Teaching positions in allied health colleges.
- Establishing independent ventures for self-employment and entrepreneurship.

Eligibility for admission: Pass in B.Sc. in Medical Laboratory Technology (BMLT) with minimum of 50% marks (40% for SC/ST and 45% for Physically Challenged candidates)

Examination: Examination rules will be as per guideline of CUTM Examination hand book.

Mini Project: As part of the course requirements, candidates are expected to undertake a mini project, as outlined in the course structure. Upon completion of the mini project, students must submit a dissertation detailing their work. The internal evaluation will include a presentation and viva-voce, which will be conducted by the respective School.

Internship: Candidates are required to complete a six-month internship at a hospital, diagnostic center, or government or private organization that is equipped with modern microbiology laboratory facilities, or at a fully equipped pathology laboratory that meets the University's established guidelines.

The dissertation is mandatory for all students. Students will conduct their dissertation work either individually or in groups of up to three. The dissertation/ internship report should follow a research thesis format, as prescribed by the University.

Degree: The degree of M.Sc. in Medical Laboratory Technology from Centurion University will be awarded to candidates who have successfully completed the prescribed two-year program, comprising a minimum of **96 course credits**, as outlined in the curriculum. This includes passing all examinations under the relevant scheme and completing a six-month compulsory internship in the final semester. Upon fulfilling these requirements, graduates will receive the **"Master of Science in Medical Laboratory Technology (M.Sc. MLT)"** degree.

Program Outcomes (POs):

PO	Outcomes
PO1	Apply knowledge of basic science and allied health science.
PO2	Design and conduct experiments, as well as to carry out problem analysis data interpretation
PO3	Design and develop process to meet desired needs within realistic constraints.
PO4	Function effectively as a leader and member of multidisciplinary teams.
PO5	Isolate, identify, synthesize, formulate and solve complex healthcare problems.
PO6	Understanding of professional and ethical responsibility
PO7	Communicate effectively
PO8	Understand the impact of allied healthcare in a global, economic, environmental, and societal context
PO9	Manage contemporary healthcare projects and their financial implications.
PO10	Use the techniques, skills, and modern healthcare instruments and tools necessary for allied health profession.
PO11	Analyze, screen and ensure quality in healthcare delivery.
PO12	Engage in life-long learning
PO13	Demonstrate a knowledge and understanding of contemporary technologies, their applications and limitations, contemporary research in the broader context of relevant fields

Program-Specific Outcomes (PSOs):

PO	Outcomes
PSO1	To analyse body fluids, tissues, and perform blood typing, chemical analyses, cell counts of human specimens.
PSO2	To determine the presence, extent or absence of disease and evaluate the effectiveness of treatment.
PSO3	To be employed in diagnosis of diseases through the use of clinical laboratory tests by helping doctors to detect and treat diseases.

PROGRAM STRUCTURE

MSc Medical Laboratory Technology

CHOICE BASED CREDIT SYSTEM (CBCS) STRUCTURE

Category	Minimum Credits to be completed	Minimum Credits to be completed
School (Core)	**14**	**96**
Discipline (Core)	**42**	
Skill Basket#	**8**	
Value Added**	**4**	
AECC	**6**	
Summer Internship##	**2**	

Project	**10**	
Internship	**10**	

#Skill course is to be registered by the student during 1st and 2nd semester.

**Value added course to be registered by the student one time in each year

##Summer Internship is to be carried out by the candidate during summer vacation post 2nd semester

BASKET I

School Core Courses

Sl. No.	CODE	SUBJECT	SUBJECT TYPE (T + P + Pj)	CREDITS
1	CUTM4284	Human Anatomy and Physiology	3+1+0	4
2	CUTM4327	Clinical Pathology	2+1+0	3
3	CUTM1721	Research Methodology	2+0+1	3
4	CUTM4328	Clinical Biochemistry	3+1+0	4
			Total Credit	**14**

BASKET II

Discipline Core Courses

Sl. No.	CODE	SUBJECT	SUBJECT TYPE (T+P+Pj)	CREDITS
1	CUTM4331	Medical Laboratory Technology	3+1+0	4
2	CUTM4329	Blood Banking	2+1+0	3
3	CUTM4318	Health Programme in India	3+0+1	4
4	CUTM4330	Advanced Hematology	2+1+0	3
5	CUTM4332	Medical Microbiology	2+1+0	3
6	CUTM4324	Medical Parasitology	2+1+0	3
7	CUTM4295	Immunology	3+1+0	4
8	CUTM4326	Analytical Techniques	2+1+0	3
9	CUTM1710	Biological Chemistry	2+1+0	3
10	CUTM1712	Clinical Hematology	3+1+0	4
11	CUTM4322	Molecular Biology and Bioinformatics	2+1+0	3

12	CUTM4323	Histopathology and Cytology	2+1+0	3
13	CUTM1754	Mini Project	0+0+2	2
			Total Credit	**40**

BASKET I

School Core Courses

HUMAN ANATOMY AND PHYSIOLOGY

Subject Name	**Code**	**Type**	**T + P + Pj**	**Credits**
Human Anatomy and Physiology	CUTM4284	Theory+ Practice	3+1+0	4

Course Objective:

- To gain comprehensive knowledge of the basic structure of the human body, including cells, tissues, organs, and systems.
- To understand how various systems of the body function and interact to maintain homeostasis and support life.
- To acquire detailed knowledge of specific systems such as the musculoskeletal, nervous, cardiovascular, respiratory, digestive, endocrine, urinary, and reproductive systems.
- To develop skills in identifying anatomical structures and understanding physiological processes through laboratory exercises, dissections, and clinical correlations.

Course Outcome:

After completion of the course, the students will be able to,

Cos	Statements	COs With POs and PSOs Mapping
CO1	Understand the major anatomical terminologies.	PO1, PO7, PO12
CO2	Know the basic concept of human anatomy and physiology.	PO1, PO3, PSO1
CO3	Identify locations of major organs of each system.	PO1, PO10, PO11
CO4	Analyse interrelationships at molecular, cellular and tissue level.	PO2, PO5, PO13, PSO2
CO5	Apply the knowledge for understanding the functions of different organs in human body.	PO1, PO4, PO8, PSO3

Course Outline:

Module-I

Scope of Anatomy and physiology. Terms and terminology used in Anatomy. Structure of cell, function of its components with special reference to mitochondria and microsomes. Elementary tissues: Anatomy of epithelial tissue, muscular tissue, connective tissue and nervous tissue.

Practice: Identification of different organs and system from chart.

Module-II

Skeletal System: Skeleton system with classification, types of bone, features of long bone, ossification, blood supply, Joints – classification with examples, structure of typical synovial joints, Joint disorders.

Practice: Demonstration of individual bone from skeleton.

Module-III

Cardiovascular System: Composition and functions of blood. Blood groups – ABO system and Rh factor and coagulation of blood. Brief information regarding disorders of blood. lymph – origin, circulation, functions of lymph and lymph nodes. Structure and functions of various parts of the heart. Blood pressure and its recording. Brief information about cardiovascular disorders. Respiratory system: Introduction and functional anatomy of respiratory tract, physiology of respiration.

Practice: Demonstration of the morphology of different blood cells. Measurement of Blood pressure, impulses, Heart beats, respiration rate etc.

Module-IV

Urinary System: Various parts of the urinary system and their functions, structure and functions of the kidney. Physiology of urine formation. Patho-physiology of renal diseases and edema. Digestive System: Anatomy of digestive system and their functions. Structure and functions of liver, physiology of digestion and absorption.

Practice: Demonstration of various parts of the urinary system and digestive system.

Module-V

Endocrine System: Endocrine glands and Hormones. Reproductive system. Structure and function of sense organs.

Practice: Demonstration of various parts of the endocrine and reproductive systems.

Suggested Readings:

1. Text book Anatomy & Physiology for nurses by Evelyn Pearce, Publisher Faber &Faber.
2. Text book Anatomy and Physiology for nurses by Sears, Publisher Edward Arnold.
3. Anatomy & Physiology- by Ross and Wilson, Publisher Elsevier.
4. Anatomy& Physiology: Understanding the human body by Clark, Publisher Jones & Bartlett.
5. Anatomy and Physiology for nurses by Pearson, Publisher Marieb&Hoehn.
6. Anatomy and Physiology by N Murgesh, Publisher Satya.

CLINICAL PATHOLOGY

Subject Name	Code	Type	T + P + Pj	Credits
Clinical Pathology	CUTM4327	Theory+ Practice	2+1+0	3

Course Objective:

- To develop a comprehensive understanding of the pathophysiological mechanisms underlying common diseases and disorders affecting different body systems.
- To acquire knowledge of various laboratory techniques and diagnostic tests used in clinical pathology, including hematological, biochemical, microbiological, and histopathological tests.
- To understand the principles of specimen collection, handling, processing, and the importance of quality control in clinical pathology.
- To apply theoretical knowledge to the identification of pathological changes in tissues and organs through microscopic and other diagnostic techniques.

Course Outcome:

After completion of the course, the students will be able to,

Cos	**Statements**	**COs With POs and PSOs Mapping**
CO1	Execute the technique of collection of pathological specimens.	PO1, PO10, PO11, PSO2
CO2	Understand preservation and processing of pathological samples.	PO1, PO2, PO11, PSO1
CO3	Identify the causative agents of infectious diseases.	PO1, PO5, PO13, PSO1, PSO2
CO4	Interpret Gram staining and ZN staining results to diagnose respiratory infections, differentiate between amoebic and bacillary dysentery, and assess the presence of pathogens in various body fluids.	PO1, PO2, PO5, PO10, PO11, PSO2
CO5	Evaluate human abnormalities through clinical investigations.	PO1, PO4, PO5, PO8, PO11, PSO3

Course Outline:

Module-I

Physical & Chemical Examination of Urine: Sugar, ketone bodies, diabetes, nephritis, UTI, etc. Microscopical Examination of Urine: Including operation of the urine analyzer. Special Tests: Pregnancy test, multistix reagent strip, jaundice, albumin, phosphate, BJP, bile salt and pigment.

Lab & Practice: Benedict test, Rothera's test, Fouchet's test, urine analyzer operation, and other urine tests.

Module-II

Respiratory Tract Infection: Gram staining, ZN staining, and DOT centers. Sputum Analysis: For diagnosis of Mycobacterium tuberculosis. Clinical Significance & Report Writing: Sputum and respiratory infections.

Throat Swab Analysis: Bacteriological examination and clinical significance.

Lab & Practice: Gram staining, ZN staining, sputum analysis. Throat swab examination.

Module-III

Physical, Chemical, and Microscopical Examination of Stool: Including differences between amoebic and bacillary dysentery. Clinical Significance of Stool Examination: For parasitic and bacterial infections.

Lab & Practice: Stool analysis, occult test, protozoa and helminth identification.

Module-IV

Pleural, Pericardial, and Synovial Fluids: Composition, collection, and routine laboratory investigation. Cerebrospinal Fluid (CSF): Related to meningitis, brain tumors, and other disorders.

Lab & Practice: Collection and examination of pleural, pericardial, synovial fluids, and CSF.

Module-V

Semen Examination: Composition, and analysis for male infertility disorders.

Lab & Practice: Semen analysis, chemical and microscopical examination

Suggested Readings:

1. Textbook of Clinical laboratory methods and diagnosis by Gradwohls, Publisher Mosby

2. Medical laboratory technology Vol.1 by K. L. Mukherjee, 2007, Publisher Tata McGrawHill Textbook of medical laboratory technology by Praful B Godkar, Publisher Bhalan
3. Medical laboratory science theory and practice by J Ochei and Kolhatkar, 2002, Tata McGraw- Hill, Publisher TBS

RESEARCH METHODOLOGY

Subject Name	Code	Type	T + P + Pj	Credits
Research Methodology	CUTM1721	Theory+ Project	2+0+1	3

Course Objective:

- To gain a solid understanding of the fundamental concepts, types, and importance of research in scientific inquiry and academic fields.
- To learn how to formulate research problems, hypotheses, and objectives, as well as how to design and structure research projects.
- To understand and apply various methods of data collection, including surveys, experiments, interviews, and observation, while ensuring accuracy and reliability.
- To become proficient in using statistical tools and techniques for analyzing and interpreting data.

Course Outcome:

After completion of the course, the students will be able to,

Cos	Statements	COs With POs and PSOs Mapping
CO1	Identify the key components of research, including its definition, scope, limitations, types, and objectives	PO1, PO6, PO12, PSO3
CO2	Understand the steps involved in developing a health research proposal.	PO2, PO3, PO4, PO9, PSO3
CO3	Implement the methods of data collection.	PO1, PO2, PO10, PO11, PSO2
CO4	Interpret the concepts of sampling designs, the theory of estimation and hypothesis testing, and the significance tests based on t, F, Z, and Chi-Square tests	PO2, PO5, PO13, PSO2, PSO3
CO5	Evaluate the importance of tabulation, coding, editing, interpretation, and report writing in the research process.	PO7, PO9, PO12, PSO3

Course Outline:

Module- I

Introduction to Research**:** Definition, scope, limitations, and types of research. Objectives of Research**:** Types and importance. Research Process**:** Basic steps involved in the health research proposal development process. Literature Review**:** Importance, sources, strategies for accessing information,library and computer search techniques.

Project Topics:

1. Impact of Digital Library Systems on Literature Review Effectiveness in Health Research
2. Evaluating the Scope and Limitations of Research in Rural Healthcare Development
3. Comparative Study of Traditional vs. Modern Research Methods in Public Health

Module- II

Research Title and Objectives**:** Criteria for selecting a research title. Formulation of Research Objectives**:** Types and qualities of research objectives. Research Designs**:** Different types of research designs and their applicability to various research contexts.

Project Topics:

1. Exploring Factors Influencing Research Title Selection in Epidemiological Studies
2. Formulating Research Objectives for Preventing Lifestyle Diseases Among Urban Youth
3. Analyzing the Applicability of Experimental vs. Observational Research Designs in Community Health Projects

Module- III

Data Collection Methods**:** Secondary and primary data collection techniques. Scaling Techniques**:** Concept, types, rating scales, ranking scales, scale construction techniques, and multi-dimensional scaling. Sampling Designs**:** Concepts, types, techniques, and sample size determination.

Project Topics:

1. Effectiveness of Primary Data Collection Techniques in Monitoring Pandemic Outbreaks
2. Assessing Multi-Dimensional Scaling in Consumer Preferences for Health Products
3. Sampling Techniques in Determining Prevalence Rates of Non-Communicable Disease

Module- IV

Research Hypothesis**:** Definition, qualities, importance, and types of hypotheses. Theory of Estimation**:** Testing of hypothesis, small and large sample tests. Statistical Tests**:** Tests of significance based on t, F, Z, and Chi-Square tests.

Project Topics:

1. Hypothesis Testing for the Impact of Yoga on Mental Health in Adolescents
2. Statistical Analysis of Health Outcomes in Smokers vs. Non-Smokers Using Chi-Square Tests
3. Small and Large Sample Testing to Study Vaccination Rates in Urban vs. Rural Areas

Module- V

Designing Questionnaire & Interviewing**:** Techniques for effective data collection. Tabulation, Coding, Editing**:** Organizing and processing research data. Interpretation and Report Writing**:** How

to analyze results and prepare research reports.

Project Topics:

1. Designing Questionnaires to Assess Public Awareness of Reproductive Health
2. Developing an Interview Framework to Study Health-Seeking Behavior in Low-Income Communities
3. Tabulation and Statistical Interpretation of Survey Data on Patient Satisfaction in Hospitals

Suggested Readings:

1. Research Methodology by C.R. Kothari (3rd Ed)
2. Research Methodology In the Medical & Biological Sciences by Petter Laake et al.
3. Essentials of Research Design and Methodology by Geoffrey Marczyk et al.
4. WHO, Health Research Methodology: A guide for training in research Methods, 2nd Edition, WHO- WIPRO
5. A Student's Guide to Methodology by Clough P and Nutbrown C. Sage Publication.
6. National Ethical Guidelines for Health Research in Nepal, Available at Nepal Health Research Council.
7. Field Trials of Health Interventions in Developing Countries by Smith PG, Morrow.

CLINICAL BIOCHEMISTRY

Subject Name	Code	Type	T + P + Pj	Credits
Clinical Biochemistry	CUTM4328	Theory+Practice	3+1+0	4

Course Objective:

- To develop a deep understanding of various biochemical tests, including liver function tests (LFT), kidney function tests (KFT), lipid profile, and glucose estimation, and their

clinical significance.

- To acquire knowledge and skills in assessing and interpreting hormonal tests such as T3, T4, TSH, Prolactin, and Kito steroids.
- To understand the role of diagnostic enzymes in clinical practice, including the use of marker enzymes for detecting myocardial, liver, and pancreatic conditions, as well as tumor markers.
- To understand the application of advanced diagnostic tools and their role in clinical practice for diagnosing and monitoring diseases.

Course Outcome:

After completion of the course, the students will be able to,

Cos	Statements	COs With POs and PSOs Mapping
CO1	Identify and list the components of different clinical tests such as LFT, KFT, lipid profile, glucose estimation, and hormone tests.	PO1, PO11, PSO1
CO2	Recall the principles of various diagnostic techniques including colorimetry, radioisotope techniques, and the concepts related to various organ function tests.	PO1, PO13, PSO1, PSO2
CO3	Explain the mechanisms behind different organ function tests, including liver and kidney function tests, as well as the process of urine formation and renal function assessment.	PO1, PO2, PO5, PSO1, PSO2
CO4	Apply their knowledge to demonstrate the operation of laboratory equipment as well as perform techniques for biochemical investigations.	PO1, PO10, PO11, PSO2
CO5	Analyze the role of different diagnostic enzymes and tumor markers in clinical practice.	PO1, PO5, PO11, PSO1, PSO3

Course Outline:

Module I

Liver Function Tests (LFT): Estimation of liver function parameters. Kidney Function Tests (KFT): Estimation of renal function. Lipid Profile: Understanding the assessment of lipid levels. Glucose Estimation: Techniques for glucose tolerance test and other glucose-related assessments. Hormonal Tests: T3, T4, TSH, Prolactin, and Keto steroids.

Practice: Demonstration of centrifuge machine and colorimeter, glucose tolerance test, urine sugar detection, protein estimation in urine.

Module II

Metabolic Disorders: Disorders of carbohydrate, lipid, amino acid, and nucleic acid metabolism. Diagnostic Enzymology: Role of enzymes in clinical practice. Marker Enzymes: For myocardium, liver, pancreas, and tumor markers. Radio Isotope Techniques: Basics of isotopic techniques in diagnostics.

Practice: Assessment methods for liver and kidney functions, lipid profile, and thyroid testing.

Module III

Liver Function: Bile pigment metabolism, liver function tests, types of jaundice. Kidney Function: Urine formation, renal function tests, kidney diseases. Renal Calculi: Formation theory and analysis of kidney stones.

Practice: Estimation of liver and kidney function tests, bile pigment and bilirubin estimation.

Module IV

Clinical Enzymology: Focus on enzyme markers for different organs (heart, liver, pancreas). Tumor Markers: Role in identifying specific cancers and assessing treatment efficacy. Radioisotopic Methods: Role of radioisotopes in tracking and diagnosing organ functions.

Practice: Marker enzyme assays for clinical diagnostics.

Module V

Gastric Function Tests: Gastric juice composition, free and bound acid, fractional test meal. Advanced Diagnostic Tools: Centrifuge machine operation, gastric function tests.

Practice: Estimation procedures for bile pigments, bile salts, and bilirubin, gastric juice analysis, and advanced organ function testing.

Suggested Readings:

1. Text book of Medical Laboratory Technology by P. B. Godker, PublisherBhalani.
2. Text book of Medical Biochemistry by Chaterjee & Shinde, PublisherJPB
3. Medical Laboratory Technology by Mukherjee
4. Principal of Biochemistry by Lehninger, Publisher Kalyani
5. Practical Clinical Biochemistry by Harold Varley, Publisher CBS.
6. E book link
   https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/health_ science_students/medicalbiochemistry.pdf
7. E book link-
   https://books.google.co.in/books?id=Je_pJfb2r0cC&printsec=frontcover&source=gbs_ge_sum mary _r&cad=0#v=onepage&q&f=false
8. E book link-
   https://books.google.co.in/books?id=csPcDAAAQBAJ&printsec=frontcover&source=gbs_ge_s ummary _ r&cad=0#v=onepage&q&f=false
9. E book link-
   https://books.google.co.in/books?id=2FkXAwAAQBAJ&printsec=frontcover&sourc e=gbs_ge_ summary _ r&cad=0#v=onepage&q&f=false

BASKET II

Discipline Core Courses

MEDICAL LABORATORY TECHNOLOGY

Subject Name	Code	Type	T + P + Pj	Credits
Medical Laboratory Technology	CUTM4331	Theory+ Practice	3+1+0	4

Course Objective:

- To understand the concept of Medical Laboratory Science
- To diagnose the Disease
- To understand the Rules and Regulations for clinical laboratory
- To study Auto mentation technique in diagnostic division

Course Outcome:

After completion of the course, the students will be able to

COs	Statements	COs with POs and PSOs Mapping
CO1	Understand the basic principles, organization, and code of conduct of medical laboratories.	PO1, PO6, PO10, PO11, PO12, PO13, PSO3
CO2	Demonstrate the need of microscopic analysis in laboratory diagnosis	PO1, PO2, PO5, PO10, PO11, PO13, PSO1, PSO3
CO3	Analyse the significance of sensitive and accurate diagnosis in the detection of disease.	PO1, PO2, PO5, PO13, PSO2, PSO3
CO4	Evaluate the importance of proper specimen collection, transportation, and preservation techniques to ensure accurate lab results	PO1, PO2, PO3, PO5, PO8, PO9, PO10, PO11, PO12, PO13, PSO1, PSO3
CO5	Maintain good lab practice and design laboratory set up.	PO1, PO2, PO3, PO5, PO6, PO8, PO9, PO10, PO11, PO12, PO13, PSO1, PSO3

Course Outline:

Module-I

Basic principle of medical laboratory , Code of conduct in medical laboratory, Organization of clinical laboratory, Functional components of clinical lab, Role of medical laboratory technician, Communication between physician and lab technician.

Practice: Observation of Lab Equipment's

Module-II

PPE in labs, Standardised clinical lab setup, Various types of laboratories, Lab safety protocols and First-Aid in clinical laboratory, Different types of laboratory records,

Responsibilities of lab workers.

Practice: PPE Equipments, Lab record maintenance, Lab setup process.

Module-III

Auto-Mentation in Medical Laboratories, role of automation in improving diagnostic accuracy and efficiency, operation of automation system in diagnostic division.

Practice: Operation of automation system

Module-IV

Clinical establishment Act, Quality control for clinical lab, NABH, NABL (National accreditation board of laboratory), ISO Certification, Annual maintenance contract, Procurement and supply management

Practice: Documents required for the Laboratory set up, equipment management and maintenance planning.

Module-V

WHO policies for medical laboratories, Important instructions to minimize infection during laboratory work, Bio-medical waste management, Laboratory management and patient care, Personal care and hygiene in laboratories

Practice: Bio-medical waste management procedures, Patient care practices in labs.

Suggested Readings:

1. Handbook of Medical laboratory technology by V. H. Talib, Publisher CBS Publisher and distributors
2. Medical laboratory technology Vol.1 by K. L. Mukherjee, 2007, Publisher Tata McGrawHill
3. Textbook of Histology (color atlas) by Krishna Garg, Indira Bahl, Mohini kaul, publisher CBS
4. Practical Pathology by Harsh Mohan
5. Textbook of medical laboratory technology by Praful B Godkar, Publisher Bhalan
6. Medical laboratory science theory and practice by J Ochei and Kolhatkar, 2002, Tata McGraw- Hill, Publisher TBS

BLOOD BANKING

Subject Name	Code	Type	T + P + Pj	Credits
Blood Banking	CUTM4329	Theory+ Practice	2+1+0	3

Course Objective:

- To understand blood bank methods and demonstrate knowledge of testing procedures.
- To learn about anticoagulants used in blood banks.
- To Gain knowledge of blood regulation policies and their implementation.
- To explain solid organ transplantation, related policies, and transfusion reactions.

Course Outcome:

After completion of the course, the students will be able to

COs	Statements	COs with POs and PSOs Mapping
CO1	Understand the basic principle of blood banking.	PO1, PO6, PO10, PO11, PO12, PO13, PSO3
CO2	Perform blood group systems, including ABO and Rhesus systems.	PO1, PO2, PO5, PO10, PO11, PO13, PSO1, PSO3
CO3	Demonstrate auto mentation technique used in blood bank.	PO1, PO2, PO5, PO8, PO10, PO11, PO12, PO13, PSO1, PSO3
CO4	Evaluate pre-transfusion testing protocols, compatibility tests, cross-matching procedures, and precautions for blood component infusion.	PO1, PO2, PO3, PO5, PO8, PO10, PO11, PO12, PO13, PSO1, PSO2, PSO3
CO5	Investigate transfusion reactions.	PO1, PO2, PO3, PO5, PO6, PO8, PO10, PO11, PO12, PO13, PSO2, PSO3

Course Outline:

Module-I

Basic principle in blood banking, Blood bank organisation, Planning and documentation,NACO Blood bank policy, National blood policy, Equipment used in blood bank. Anticoagulantuse in blood bank, Selection of blood donor

Practice: Documentation process, Setting up a blood bank, Operation of blood bank equipment.

Module - II

Auto-mentation technique used in blood bank, Techniques used for the separation of blood constituent, Blood preservation, Special investigation for processing of blood under the guide lines of NACO, Routine investigation for processing of blood, Phlebotomy in blood bank, Quality control in blood bank

Practice: Phlebotomy in blood bank, Cross matching and compatibility test, Rhesus and human blood group system

Module-III

Blood transfusion alternative, Prevention of diseases transmitted through blood transfusion, Transfusion reaction investigation, Transfusion reaction, Precaution taken for infusion of blood components, Pre- transfusion

Practice: Routine hematological test, HIV, VDRL, Hbs-Ag, Other STD Test.

Module-IV

Blood transfusion in solid organ transplantation, Exchange of blood transfusions, pre-surgical blood transfusion planning, blood and blood component transfusions, selection of appropriate blood components, apheresis and hemapheresis techniques

Practice: Planning and documenting blood transfusions for solid organ transplant patients.

Module-V

Blood regulation policies, NACO guidelines for blood bank operations, National and international blood donation policies, Quality control measures in blood banks, Role of red cross society in blood bank.

Practice: Analysis of blood bank regulations and quality control.

Suggested Readings:

1. Textbook of Clinical laboratory methods and diagnosis by Gradwohls, Publisher Mosby
2. Modern Blood Banking and transfusion Practice by Denise M Harming
3. Standards of blood bank by NACO http://naco.gov.in/sites/default/files/Standards%20for%20Blood%20Banks%20and%20B lood %20Transfusion%20Services.pdf
4. Handbook of blood banking and transfusion medicine http://www.uomisan.edu.iq/library/admin/book/77040715888.pdf
5. Medical laboratory technology Vol.1 by K. L. Mukherjee, 2007, Publisher Tata McGrawHill
6. Textbook of medical laboratory technology by Praful B Godkar, Publisher Bhalan
7. Medical laboratory science theory and practice by J Ochei and Kolhatkar, 2002, Tata McGraw- Hill, Publisher TBS

HEALTH PROGRAMME IN INDIA

Subject Name	Code	Type	T + P + Pj	Credits
Health Programme in India	CUTM4318	Theory+ Project	3-0-1	4

Course Objective:

- To understand the efficiency of health education and health promotion programmes.
- To know efficiency and effectiveness for the Healthcare industry.
- To think and improving access to and efficiency of primary health care.
- To explain various health programmes in India.

Course Outcome:

After completion of the course, the students will be able to

COs	**Statements**	**COs with POs and PSOs Mapping**
CO1	Identify health policies for improvement of overall health and well-being in India.	PO1, PO6, PO8, PO9, PO13,PSO3
CO2	Understand the principle of public health.	PO1, PO8, PO10, PO12, PO13, PSO2, PSO3
CO3	Apply their understanding by identifying the objectives and goals of various health programs	PO2, PO3, PO5, PO9, PO11, PSO2, PSO3, PSO2, PSO3
CO4	Demonstrate the skills required to work towards the development of health conditions in underserved areas of India.	PO4, PO5, PO8, PO10, PO11, PO13, PSO2, PSO3
CO5	Create awareness regarding women and child welfare.	PO6, PO7, PO8, PO9, PO12, PSO3

Course Outline:

Module I:

Introduction to Health Programmes in India, Voluntary Health Agencies in India, Indian Red Cross Society, Central Social Welfare Board, Indian Council for Child Welfare.

Project Topic: Impact of Voluntary Health Agencies in Promoting Public Health in India

Module II:

Family Planning Association of India, National Programme for Control of Blindness, National Tuberculosis Programme.

Project Topic: Evaluation of Family Planning Programs and Their Effectiveness in India

Module III:

National Leprosy Eradication Programme, National Programme for Health Care of Elders.

Project Topic: Assessment of National Tuberculosis and Leprosy Eradication Programmes

Module IV:

National Programme for Prevention and Control of Cancer, Diabetes, Cardiovascular Disease.

Project Topic: Analysis of the National Programme for Health Care of Elders in India

Module V:

National Immunization Programme, AYUSH - Objectives and Goals.

Project Topic: Preventive Healthcare: A Study on National Programmes for Cancer, Diabetes, and cardiovascular diseases

Suggested Readings:

1. Park, K. (2020). *Park's Textbook of Preventive and Social Medicine* (25th ed.). M/S Banarsidas Bhanot Publishers.

2. Rao, K. S., & Gopakumar, K. (2009). *Essentials of Public Health and Community Medicine*. CBS Publishers & Distributors.
3. Goel, S. L. (2009). *Social Welfare Administration in India*. Deep & Deep Publications.
4. Chaudhuri, K. P., & Singh, M. (2011). *Family Planning and Population Control in India*. PHI Learning Pvt. Ltd.
5. Health Programmes in India by Dhar L.N.
6. Public Health in India by Monica Das Gupta and Manju Rani.
7. Health Care System and Health Policy in India by D.K. Taneja.

ADVANCED HEMATOLOGY

Subject Name	Code	Type	T + P + Pj	Credits
Advanced Hematology	CUTM4330	Theory+Practice	2+1+0	3

Course Objective:

- The overall aims are that the student should obtain advanced knowledge of the most common hematologic diseases & understanding the concept of Blood cells and other blood components.
- Demonstrate an understanding of the components of human blood and characteristics, functions, and abnormalities and disease states of each.
- Demonstrate proficiency in the skills necessary to perform blood cell counts, and evaluation of blood elements within stated limits of accuracy.
- Determine suitability of hematology specimens and dispose of them in the appropriate bio-hazard containers.

Course Outcome:

After completion of the course, the students will be able to

COs	Statements	COs with POs and PSOs Mapping
CO1	Understand the use of basic equipment essential for working in a hematology laboratory.	PO1, PO6, PO10, PO11, PO12, PSO1, PSO3
CO2	Perform investigations of bleeding disorders.	PO1, PO2, PO5, PO10, PO11, PO13, PSO1, PSO2, PSO3
CO3	Compare and contrast hematology values under normal and abnormal conditions.	PO1, PO2, PO5, PO8, PO11, PO12, PO13, PSO1, PSO2, PSO3
CO4	Evaluate the process of bone marrow processing and staining.	PO2, PO3, PO5, PO10, PO11, PO12, PO13, PSO1, PSO3
CO5	Compare and contrast hematology values under normal and abnormal conditions.	PO1, PO2, PO5, PO8, PO11, PO12, PO13, PSO1, PSO2, PSO3

Course Outline:

Module-I

Quality assurance in hematology, Protocol, Statistical analysis i.e. Standard deviation, Co-efficient variation, accuracy and precision, Safety precautions in hematology. Basic concepts of automation in hematology with special reference to: Blood cell counter, Coagulometer.

Practice: Data and record Maintain, Handling hematological equipments.

Module-II

Bone marrow: Composition, processing, functions and examination (differential cell counts and cellular ratios)., Aspiration of bone marrow (Adults and children), Special Stain for Bone Marrow -Periodic Acid Schiff, Sudan Black,staining of trephine biopsy specimens.

Practice: Method of aspiration bone marrow, method of Processing and staining of trephine biopsy.

Module-III

L.E. cell phenomenon. Definition of L.E. cell, Demonstration of L.E. cell by various methods, Clinical Physiological variations in Hb, PCV, TLC and Platelets. Investigations of a case suffering from bleeding disorders. Quantitative assay of coagulation factors - a. Principle b. Procedure c. Mechanism d. Tests Biomedical waste management in hematology laboratory (Other than Radioactive material)

Practice-: Demonstration of functional aspect of blood cell counter Study the RBCs abnormal morphological , Immature Erythroid series of cells,Immature Myeloid and other WBCs series of cells

Module-IV

Leukemia: Classification, Laboratory diagnosis of leukemia's, Blood Picture, Advanced techniques in the diagnosis of leukemia, Identification of abnormal blast cells, Evaluation of differential leukocyte counts. Techniques for processing bone marrow samples. Differentiation of Blast Cells.

Practice-: Blood Smear Preparation and Examination, Differential Leukocyte Count (DLC)

Module-V

Investigation of bleeding disorders and quantitative assays of coagulation factors. Principles, procedures, mechanisms, and tests for coagulation factor assays, Tests of coagulation disorders – Screening tests – PT, APTT, Thromboplastin time & thrombin time. Second line tests – mixing experiments, factor assays FDP

Practice: PT, APTT, Thromboplastin time &thrombin time, Differentiation of blast cells in leukemia. Analysis of bone marrow differential counts.

Suggested Readings:

1. Textbook of Medical Laboratory Technology P.B Gotkar Mumbai, Bhalani Publishing

House

2. Text book of Medical Laboratory Technology by Paraful B. Godkar, Publisher Bhalani

3. Text book of Medical Laboratory Technology (2nd edition) by V.H Talib, Publisher CBS

4. Atlas of hematology (5th edition) by G.A. McDonald, Publisher Churchill Livingstone

5. Medical Laboratory Technology By K.L Mukharjee, Publisher McGraw Hill education pvtlimited

6. Text book of Medical Laboratory Technology (6th edition) by Ramnik Sood,Jaypee Publication.

7. E.Book link- https://www.pdfdrive.com/hematology-basic-principles-and-practice- e176384006.html

8. E. Book Link- https://www.pdfdrive.com/hematology-basic-principles-and-practice-expert- consult- online-and-print-expert-consult-title-online-print-5th-edition-e186195241.html

9. E.Book link https://books.google.co.in/books?id=6sfacydDNsUC&printsec=frontcover&dq=hematology&hl=en&sa=X&ved=2ahUKEwja9ve3I7qAhUwzTgGHSMUDekQ6wEwAHoECAQQAQ# v=onepage&q=hematology&f=false\

10. E.book link- https://books.google.co.in/books?id=QQcYAAAAYAAJ&printsec=frontcover&dq=hematology&hl=en&sa=X&ved=2ahUKEwja9ve3I7qAhUwzTgGHSMUDekQ6wEwAnoECAIQAQ #v=onepage&q=hematology&f=false

MEDICAL MICROBIOLOGY

Subject Name	Code	Type	T + P + Pj	Credits
Medical Microbiology	CUTM4332	Theory+ Practice	2+1+0	3

Course Objective:

- To understand the etiological agents responsible for global infectious diseases.
- To explore the biology of bacteria, viruses, and other pathogens associated with infectious diseases in humans.
- To develop diagnostic skills in microbiology, focusing on the practical application of laboratory tests.
- To interpret laboratory findings for the accurate diagnosis and management of infectious diseases.

Course Outcome:

After completion of the course, the students will be able to

COs	Statements	COs with POs and PSOs Mapping
CO1	Understand different antibiotics from the viewpoint of targets and resistance mechanisms.	PO1, PO2, PO5, PO8, PO11, PO12, PSO1, PSO2, PSO3
CO2	Demonstrate the significance of medically important microbes.	PO1, PO5, PO6, PO8, PO10, PSO1, PSO2, PSO3
CO3	Analyse the important microbial pathogens, their pathogenesis, diagnosis, and prevention.	PO1, PO2, PO5, PO8, PO11, PO13, PSO1, PSO2, PSO3
CO4	Evaluate different microbial detection techniques.	PO1, PO2, PO3, PO5, PO10, PO11, PO12, PSO1, PSO3

CO5	Integrate techniques to identify and differentiate between bacteria, viruses, and fungi causing diseases.	PO1, PO2, PO5, PO8, PO11, PO12, PO13, PSO1, PSO2, PSO3

Course Outline:

Module-I

Medical Bacteriology- Anatomy and structure of prokaryotes (Detail structure of Gram positive and Gram-negative bacteria, Peptidoglycan synthesis etc). Classification of bacteria based on both cell wall and shape. Nutritional requirement of bacteria, Culture media and its types.

Practice: Preparation of media, and cultivation of bacteria.

Module-II

Biochemical test (IMViC, Catalase, Coagulase etc). Sterilization technique, different staining procedures (AFB, Flagella and Endospore staining etc). Preservation of stock cultures of bacteria.

Practice: biochemical tests for identification, Preparation of bacterial smear and staining – Gram's, Acid-fast, Staining of bacterial spores flagella, capsule.

Module-III

Pathogenesis and laboratory diagnosis of medically important Gram Positive and Gram Negative bacteria, Clinical significance of human pathogenic bacteria and their identification.

Practice: Isolation, Characterization, and identification of pathogens from various clinical specimens. Study of antibiotic sensitivity of common pathogens.

Module-IV

Medical Virology -: Morphology, general properties of viruses, detection of viruses and antigens in clinical specimens, Laboratory and Serological diagnosis of virus infections. Viral vaccines preparation and their immunization schedules. Viruses of importance to

bacteria, bacteriophages, their structure, types, typing and their application in bacterial genetics.

Practice: Serological diagnosis of viral infections and demonstration of various inoculation routes in fertilized hen egg (Egg Inoculation Method).

Module-V

Medical Mycology -: Morphology, general characteristic, taxonomy, classification of fungi, detection and recovery of fungi from clinical specimens. Dermatophytes and agents of superficial mycoses. Trichophyton. Epidermophyton and Microsporum. Yeasts of medical importance, Candida, Cryptococcus, detail information with lab diagnosis of human pathogenic Fungus.

Practice: Preparation of culture media used routinely in mycology, staining technique for identification of fungi, isolation, and identification of fungi from clinical specimens.

Suggested Readings:

1. Medical Laboratory Technology by Kanai Lal Mukherjee, Publish Tata McGrawHill
2. An Introduction to Medical Laboratory Technology by FJ Baker; Butterworth
3. Practical Book of Medical Microbiology by Satish Gupta, Publisher JPBrothers
4. Medical Laboratory Manual for Tropical Countries Vol. I and II by Monica Chees brough.
5. Textbook of Medical Laboratory Technology by Praful BGodkar.
6. Biology of Microorganism by Brock 14th Ed.

Medical Parasitology

Subject Name	Code	Type	T + P + Pj	Credits
Medical Parasitology	CUTM4324	Theory+ Practice	2+1+0	3

Course Objective:

- To learn the definition, scope, and historical background of parasitology, including the host-parasite relationship.
- To explore host defense mechanisms and the immune responses triggered by parasitic infections.
- To delve into the life cycle, pathogenesis, and clinical features of key parasitic diseases.
- To develop proficiency in diagnostic tools like microscopy, staining techniques, serological tests, and molecular methods for detecting parasitic infections.

Course Outcomes:

After completion of the course, the students will be able to,

Cos	Statements	COs With POs and PSOs Mapping
CO1	Explain the definition, scope, and historical background of parasitology and understand the classification of various parasites.	PO1, PO6, PO12, PSO1
CO2	Identify the methods of transmission for parasitic diseases and describe the role of vectors in the life cycle of parasites.	PO1, PO5, PO8, PSO1, PSO3
CO3	Diagnose helminth infections like schistosomiasis, fascioliasis, and ascariasis through laboratory techniques and suggest treatment options.	PO1, PO2, PO5, PO10, PSO1, PSO2

CO4	Assess the reliability and accuracy of various diagnostic techniques.	PO2, PO5, PO11, PSO2
CO5	Evaluate existing parasitic disease control measures, identifying strengths and areas for improvement in public health programs.	PO1, PO8, PO9, PO11, PSO3

Course Outline:

Module I:

Definition, scope, and historical background, Host-parasite relationships, Classification of parasites (Protozoa, Helminths, Arthropods), Host defense mechanisms and immune response to parasitic infections, Methods of transmission and vector roles.

Practice: Collection & transport of specimens for examination of stool for parasites identification. Examination of other body fluids for parasites identification.

Module II:

Amoebiasis: Entamoeba histolytica – life cycle, pathogenesis, and diagnosis, Giardiasis: Giardia lamblia, Leishmaniasis: Leishmania donovani, visceral and cutaneous forms, Malaria: Plasmodium species, life cycle, clinical features, laboratory diagnosis, and treatment, Toxoplasmosis: Toxoplasma gondii, Trichomoniasis: Trichomonas vaginalis

Practice: Concentration techniques for demonstration of Ova (Principles and applications). Routine Stool examination for detection of intestinal parasites. Giemsa stain for Plasmodium spp.

Module III

Cestodes: Taenia solium (Pork tapeworm), Echinococcus granulosus (Hydatid disease)

Trematodes: Schistosoma spp. (Schistosomiasis), Fasciola hepatica (Liver fluke)

Practice: Identification of adult worms from model's or slide's.

Module IV

Nematodes: Ascaris lumbricoides (Ascariasis), Ancylostoma duodenale (Hookworm), Enterobius vermicularis (Pinworm), Wuchereria bancrofti (Lymphatic filariasis)

Practice: Thick and thin blood smears for filarial parasite detection

Module V

Diagnostic Techniques in Parasitology: Microscopy, staining methods (e.g., Giemsa, KOH, iodine), Serological tests (e.g., ELISA, IFA), Molecular techniques (e.g., PCR, DNA probes),

Culture methods, Antigen/antibody detection methods

Practice: Serological tests for parasitic infections.

Suggested Readings:

1. Parasitology book by K.D. Chatterjee. e-book link- https://sites.google.com/site/bkthrtrpazg/atahrgiwu. https://www.goodreads.com/book/show/24366965-parasitology-protozoology-and helminthology-with-two-hundred-fourteen
2. Textbook of medical Parasitology. e-book link- https://www.pdfdrive.com/textbook-of-medical-parasitology-textbook-of-medical- parasitology-e128716897.html

Immunology

Subject Name	Code	Type	T + P + Pj	Credits
Immunology	CUTM4295	Theory+ Practice	3+1+0	4

Course Objective:

- To gain knowledge of the immune system's components, organization, and mechanisms of immune responses.
- To understand the differences and interactions between innate and adaptive immunity, focusing on cellular and molecular mechanisms.
- To develop practical skills in immunological testing methods and their applications in disease diagnosis and therapy.
- To explore vaccine development, immunotherapy, and emerging advancements in immunotechnology.

Course Outcomes:

After completion of the course, the students will be able to,

Cos	Statements	COs With POs and PSOs Mapping
CO1	Understand the concept of Innate & adaptive immunity.	PO1, PO5, PO12, PSO1
CO2	Apply application of immunology in disease diagnosis.	PO1, PO5, PO10, PSO1, PSO2
CO3	Analyse clinically relevant serological samples for Ag- Ab interaction.	PO1, PO2, PO11, PSO2
CO4	Justify and interpret diagnostic results of patient sample.	PO2, PO5, PO11, PSO2, PSO3
CO5	Interpret types of Hypersensitivity reactions.	PO1, PO5, PO8, PSO1, PSO3

Course Outline:

Module-I

Immunity: Classification, Measurement of immunity, Local immunity, Herd immunity.

Module-II

Antigens: Types of antigen, Epitope. Biological Classes of antigens, Superantigens.

Immunoglobulins: Antibody structure, Immunoglobin classes.

Practice: Collection of blood sample by vein puncture

Separation and preservation of serum

Module-III

Complement System: Principal pathways of Complement activation, uantitation of Complement (C)and its Components. Biosynthesis of complement, Complement Deficiencies.

Practice: Performing Serological tests: Widal test, VDRL test, ASO test, C-Reactive Protein test, Rheumatoid factor (RF) test

Module-IV

Antigen-Antibody Reactions, Antigen-Antibody measurement, Parameters of serological tests. Serological Reactions.

Practice: Performing Precipitation in agarose gel

Performing Ouchterlony Double diffusion test

Demonstration of SDS-PAGE

Module-V

Immune Response: Types of Immune response, Humoral immunity, Cell-mediated Immune Responses, Cytokines, Immunological tolerance.

Hypersensitivity Reactions: Classification of hypersensitivity reactions, Type I Hypersensitivity (IgE Dependent). Type II Hypersensitivity: Cytolytic and Cytotoxic. Type III Hypersensitivity-Immune Complex-mediated, Type IV Hypersensitivity-Delayed Hypersensitivity.

Practice: Demonstration of ELISA

Demonstration of Western blotting

Suggested Readings:

1. Kuby's Immunology (7th Ed) - by J. Owen, J. Punt, S. Strandford. Macmillan HigherEducation, England. (e-book link: https://www.pdfdrive.com/kuby-immunology-7th-edition-2013- e44842271.html)
2. Roitt's Essential Immunology (13th Ed)- by Seamus J. Martin, Dennis R. Burton, Ivan M. Roitt.Wiley Blackwell. (e-book link:http://dl.mehrsys.ir/pdf-books/Roitt_s%20Essential%20Immunology%20Thirteenth%20Edition(www.myuptodate.com).pdf)
3. Prescott, Harley, and Klein's Microbiology (Seventh Edition)- by Joanne M. Willey, Linda M.Sherwood, Christopher J. Woolverton. McGrawHill.
4. Microbiology An Introduction (10th Edition)- by Gerard J. Tortora, Berdell R. Funke, Christine, L. Case. Pearson.

5. Text book of Microbiology (7th Edition)- by Ananthanereyan & Paniker, Publisher Universitiespress. (e-book link: https://www.pdfdrive.com/textbook-of-microbiology-e177143667.html)
6. Practical Immunology (4th Edition)- by Frank C. Hay, Olwyn M.R. Westwood. BlackwellScience. (e-Book link: https://www.pdfdrive.com/practical-immunology-d34330313.html)

Online Tutorial links:

1. Fundamentals of Immunology: Innate Immunity and B-Cell Function (Coursera link: https://www.coursera.org/learn/immunologyfundamentalsimmunitybcells)
2. Fundamentals of Immunology: T Cells and Signaling
   (Courseware link: https://www.coursera.org/learn/immunologyfundamentalstcellssignaling)

ANALYTICAL TECHNIQUES

Subject Name	Code	Type	T + P + Pj	Credits
Analytical Techniques	CUTM4326	Theory+ Practice	2-1-0	3

Course Objective:

- To understand the principles and applications of key laboratory techniques
- To gain hands-on experience with instruments like microtomes, centrifuges, chromatographs, spectrophotometers, and automated analyzers
- To explore advanced tools like flow cytometry, HPLC, FPLC, and electrophoresis in diagnostics and research
- To equip students with analytical skills to interpret data obtained from sophisticated laboratory techniques and troubleshoot common operational challenges

Course Outcome:

After completion of the course, the students will be able to,

Cos	Statements	COs With POs and PSOs Mapping
CO1	Gain knowledge in various diagnostic techniques.	PO1, PO2, PO10, PSO2
CO2	Understand basic principles of medical instruments.	PO1, PO2, PO10, PSO2
CO3	Use different biomedical instruments for sample analysis.	PO1, PO5, PO10, PSO2
CO4	Design the SOP of biomedical instruments.	PO3, PO10, PO11, PSO2
CO5	Analyze spectral studies for molecular identification	PO2, PO5, PO10, PSO2

Course Outlines:

Module–I

Bacterial Colony Counter (Principle and working). Microtomy: Sectioning, Staining and its Application. Cytometry: Types, Flow cytometry and its applications.

Practice: Demonstration of Microtome.

Module-II

Centrifugation: Principle; Preparative centrifugation, Analytical centrifugation, Density gradient centrifugation.

Practice: Demonstration of Centrifuge

Module-III

Chromatography: Principles and Applications: Paper, Thin layer, Column, Ion exchange, Affinity chromatography, Gel filtration, Gas Chromatography, HPLC, FPLC.

Practice: Demonstration of Chromatography techniques

Module-IV

Electrophoresis: Immuno-electrophoretic, Isoelectric focusing, 2-Dgel electrophoresis.

Practice: Demonstration of Electrophoresis

Module-V

Spectrophotometry: Ultraviolet, Mass spectrophotometry; Flame photometry; Principle, Instrumentation, Specimen preparation and Application of: X-ray diffraction, NMR, EPR.

Principle and Application of: Fully Automated Biochemistry Analyser, Semi- automated Biochemistry Analyser, Coagulometer.

Practice: Demonstration of Semi-automated Analyzer; Demonstration of Fully automated Analyzer.

Suggested Readings:

1. Wilson K and Walker J. (2010). Principles and Techniques of Biochemistry and Molecular Biology. 7th Ed., Cambridge University Press. (e-Book link: https://www.pdfdrive.com/principles-and-techniques-of-biochemistry-and-molecular- biology-e174866056.html)
2. Nelson DL and Cox MM. (2008). Lehninger Principles of Biochemistry, 5th Ed., W.H. Freeman and Company. (e-Book link: https://www.pdfdrive.com/lehninger-principles-of- biochemistry-5th-edition-d164892141.html)
3. Willey MJ, Sherwood LM & Woolverton C J. (2013). Prescott, Harley and Klein's Microbiology. 7thEd., McGraw Hill. (e-Book link: https://www.pdfdrive.com/prescott- harley-and-kleins-microbiology-7th-ed-e188166539.html)
4. Labs for Life (e-source link: http://labsforlife.in/InstructionalVideo.aspx)

BIOLOGICAL CHEMISTRY

Subject Name	Code	Type	T + P + Pj	Credits
Biological Chemistry	CUTM1710	Theory+ Practice	2-1-0	3

Course Objective:

- To Work to promote good health by teaching the public and other health professionals about diet and nutrition.
- To demonstrate clinical disorders, the biochemical consequences of particular disease process and the response to therapy.
- To describe the various intracellular controls that govern the rate at which the metabolic pathway functions.
- To explain the ways in which hormones work in human body and alter cellular activity by binding to intracellular receptors.

Course Outcome:

After completion of the course, the students will be able to,

Cos	Statements	COs With POs and PSOs Mapping
CO1	Acquire knowledge on normal and diseased state metabolic conditions.	PO1, PO2, PO5, PSO1
CO2	Know the role of nutrients in the metabolism of living beings.	PO1, PO5, PO8, PSO1
CO3	Apply the concepts of nutrition in health and illness.	PO5, PO8, PO9, PSO2
CO4	Review the latest developments and trends in clinical biochemistry research.	PO1, PO12, PO13, PSO3
CO5	Investigate abnormalities in physiological metabolism.	PO2, PO5, PO10, PSO2

Course Outline:

Module I

Chemical aspects of Food and Nutrition: Energy yielding nutrients and Calorific value of carbohydrates, fats and proteins. Basal metabolic rate (BMR) and Body Mass Index (BMI). The Food Pyramid.

Vitamins: History, Chemistry, Absorption, transport, and storage of Vitamins, Overview of Water-Soluble and Fat-Soluble Vitamins.

Practice: Calculation of BMR and BMI.

Module II

Water-Soluble Vitamins: Metabolic functions and Biochemical manifestations of B- Complex Vitamins : Vitamin –B1,Vitamin – B2,Vitamin-B3,Vitamin –B6, Biotin, Panthothenic acid, Folic acid, Vitamin-B12. Coenzymes of B- Complex Vitamins.

Practice: Perform chromatography (e.g., thin-layer chromatography) to identify water-soluble vitamins in urine or serum.

Module III

Fat soluble Vitamins: Vitamin -A, Vitamin - D, Vitamin-E, Vitamin- K. Metabolic Functions and Biochemical Manifestations: Absorption, Transport, and Storage. Role in the Body and Associated Disorders.

Practice: Measure prothrombin time (PT) in plasma to assess Vitamin K-dependent clotting factors.

Module IV

Cellular Respiration: Aerobic and anaerobic respiration; Energy yield and regulation. Oxidation of fatty acid, Transamination and Deamination reaction, Urea formation and transport, Ketogenesis.

Practice: Solutions: Definition, use, classification, preparation and storage. Stock and working solutions. Molar and Normal solutions of compounds and acids. (NaCl, NaOH, HCl, H_2SO_4)

Module V

Biochemical aspects of Hormone: Hormone receptors and intracellular messengers, Adenylate cyclase, protein kinase and phosphodiesterase. Role of Insulin, glucagon's, epinephrine and their mechanism of action.

Practice: Diabetes and other disorder identification.

Suggested Readings:

1. Lehninger Principles of Biochemistry. (https://www.pdfdrive.com/lehninger-principles-of-biochemistry-5th-edition-e164892141.html)
2. Fundamentals of Biochemistry: Life at the Molecular Level (https://www.pdfdrive.com/fundamentals-of-biochemistry-life-at-the-molecular- level-e186753533.html)

CLINICAL HEMATOLOGY

Subject Name	Code	Type	T + P + Pj	Credits
Clinical Hematology	CUTM1712	Theory+ Practice	3-1-0	4

Course Objective:

- The Clinical Hematology course will cover the diagnosis and management of blood cell disorders,
- To understand anatomy and physiology of hematopoiesis, routine specialized hematology tests, analysis, classification, and monitoring of blood cell abnormalities.
- To equip the students with hematological analysis for deeper understanding of normal and abnormal cell morphology with associated diseases and other blood components.
- Be able to handle an investigation of hematological disorder and laboratory abnormalities such as anaemia, polycythemia, leukopenia, leukocytosis, thrombocytopenia,

thrombocytosis, elevated ESR etc within hematology.

Course Outcome:

After completion of the course, the students will be able to,

Cos	Statements	COs With POs and PSOs Mapping
CO1	Identify the various cellular components of blood, their normal and abnormal morphology, and understand the principles of Romanwsky staining techniques.	PO1, PO2, PO5, PO10, PSO1
CO2	Recall the different methods of blood collection, preservation, and staining techniques, as well as the formulas for calculating parameters like MCH, MCV, and MCHC.	PO1, PO10, PO11, PSO2
CO3	Interpret complete blood cell counts (CBC), differentiate between normal and abnormal red blood cell morphology, and correlate the laboratory findings	PO2, PO5, PO10, PO11, PSO2
CO4	Evaluate the clinical significance of the blood indices.	PO5, PO8, PO11, PSO2
CO5	Apply their knowledge to diagnose and differentiate hematological disorders like hemophilia, von-willebrand disease, and idiopathic thrombocytopenic purpura through laboratory tests.	PO1, PO5, PO8, PO10, PSO2

Course Outline:

Module-I

Scope & Importance of Hematology: Introduction to essential tools and reagents used in hematology. **Tests Performed in Hematology Laboratory:** Basic overview of common tests

conducted. **Normal Cellular Components and Blood Formation:** Understanding the function of normal blood cells, erythropoiesis, and thrombopoiesis.

Practice: Demonstration of instruments used in hematology- Microscope, Blood Cell counter. Identification and demonstration of different blood cells and their synthesis.

Module-II

Red Blood Cell Inclusions and Blood Cell Morphology: Red Blood Cell Inclusions: Identification and confirmation of various RBC inclusions. **Morphology of Normal Blood Cells:** Understanding the normal appearance and function of blood cells. **Abnormal Morphology & Associated Diseases:** Recognizing and understanding diseases linked to abnormal cell morphology. **Hematological Disorders Overview:** Initial discussion on various disorders related to blood cells.

Practice: Demonstration of normal and abnormal blood cell morphology using slides or charts.

Module-III

Blood Collection and Preservation: Methods of Blood Collection: Venous and capillary blood collection techniques. **Blood Preservation:** Understanding changes in stored blood and preservation methods. **Anticoagulants:** Types, uses, mode of action, and their merits and demerits. **Normal and Absolute Values in Hematology:** Reference values for different blood parameters.

Practice: Blood collection techniques and blood preservation methods, Use of anticoagulants in blood preservation.

Module-IV

Hematological Testing Techniques: Preparation of Peripheral Blood Film (PBF): Techniques and significance. **Staining Methods:** Different types of stains, with a focus on Romanowsky stains and their principles. **Hemoglobin Estimation:** Techniques like oxy Hb and cyanmethemoglobin methods. **Complete Blood Cell Count (CBC):** Detailed procedures for RBC count, WBC count, Platelet count, and related parameters (DLC, HB, MCH, MCV, MCHC). **Erythrocyte Sedimentation Rate (ESR):** Methods like Westergren’s and Winrobe's. **Reticulocyte and Absolute Eosinophil Count:** Techniques and their significance.

Practice: Preparation and staining of peripheral blood films,Conducting and interpreting CBC, ESR, and other hematological tests.

Module-V

Hematological Disorders: Classification of Anemia: Morphological &etiological. Iron Deficiency Anemia: Distribution of body Iron, Iron Absorption, causes of iron deficiency, lab findingsc. Megaloblastic Anemia: Causes, Lab findings. Hemolytic Anemia: Definition, causes, classification & lab findings. Laboratory diagnosis of Hemophilia and von-will brand disease. Laboratory diagnosis of Idiopathic thrombocytopenic purpura (ITP), Platelet function tests and their interpretation.

Practice: Observation about different normal and abnormal morphology of RBCs, WBCs, Platelet, Bleeding Time & Clotting Time, PT & APTT.

Suggested Readings:

1. Textbook of Medical Laboratory Technology P.B Gotkar Mumbai, Bhalani Publishing House
2. Text book of Medical Laboratory Technology by Paraful B. Godkar, Publisher Bhalani
3. Text book of Medical Laboratory Technology (2nd edition) by V.H Talib, Publisher CBS
4. Atlas of hematology (5th edition) by G.A. McDonald, Publisher Churchill Livingstone
5. Medical Laboratory Technology By K.L Mukharjee, Publisher McGraw Hill education pvt limited
6. Text book of Medical Laboratory Technology (6th edition) by Ramnik Sood, Jaypee Publication.
7. Ebook link https://www.pdfdrive.com/hematology-basic-principles-and-practice e176384006.html
8. Ebook link

https://www.pdfdrive.com/hematology-basic-principles-and-practice-expert-consult- online-and-print-expert-consult-title-online-print-5th-edition-e186195241.html

9. Ebooklink https://books.google.co.in/books?id=6sfacydDNsUC&printsec=frontcover&dq=hema tology&hl=en&sa=X&ved=2ahUKEwja9ve3I7qAhUwzTgGHSMUDekQ6wEwAHo ECAQQAQ#v=onepage&q=hematology&f=false
10. Ebook link https://books.google.co.in/books?id=QQcYAAAAYAAJ&printsec=frontcover&dq=hematology&hl=en&sa=X&ved=2ahUKEwja9ve3I7qAhUwzTgGHSMUDekQ6wEw AnoECAIQAQ#v=onepage&q=hematology&f=false

MOLECULAR BIOLOGY & BIOINFORMATICS

Subject Name	Code	Type	T + P + Pj	Credits
Molecular Biology & Bioinformatics	CUTM4322	Theory+ Practice	2+1+0	3

Course Objective:

- To understand the molecular mechanisms of gene expression, regulation, and protein synthesis.
- To acquire knowledge of bioinformatics tools for analyzing biological data.
- To learn various techniques in molecular biology for research and diagnostic purposes.
- To develop the ability to handle biological datasets and perform computational analyses

Course Outcome:

After completion of the course, the students will be able to,

Cos	Statements	COs With POs and PSOs Mapping
CO1	Describe the salient features of DNA and RNA structure, and the key concepts related to transcription, translation, and molecular diagnostics.	PO1, PO2, PO10, PSO2
CO2	Demonstrate the ability to construct phylogenetic trees, predict protein structures, and design docking studies	PO1, PO2, PO5, PO10, PSO2
CO3	Apply molecular diagnostic techniques such as recombinant DNA technology, PCR, DNA fingerprinting, and DNA sequencing (Sanger and NGS)	PO1, PO2, PO5, PO10, PSO2
CO4	Analyze genomic and proteomic data, understanding the implications of the Human Genome Project, CRISPR-Cas9, gene therapy, and molecular mechanisms involved in cancer	PO2, PO5, PO10, PO13, PSO3
CO5	Critically evaluate bioinformatics tools and databases (NCBI, EMBL, UniProt, KEGG) for the retrieval and alignment of biological data	PO1, PO2, PO10, PSO3

Course Outline:

Module-I

Structure and Function of Nucleic Acids: DNA and RNA structure, DNA replication, transcription, and translation, Post-transcriptional modifications and post-translational modifications, Gene Regulation: Operons, promoters, enhancers, and silencers

Practice: Demonstration of Bacterial DNA Isolation technique

Module-II

Molecular diagnostics: Recombinant DNA Technology and its applications, Polymerase chain reaction and its application in diagnosis of pathogens, DNA finger printing, DNAse Foot Printing, antisense RNA technology, DNA sequencing: Sanger and Next-Generation Sequencing (NGS)

Practice: Demonstration of PCR

Module-III

Advanced Molecular Biology: Genomics and Proteomics, Human genome project and applications, Proteomics: protein identification and characterization, CRISPR-Cas9 and gene editing techniques, Gene therapy and its applications in medicine, Oncogenes, tumor suppressor genes, Molecular mechanisms of cancer, Genetic disorders and molecular diagnostics

Practice: Demonstration of Plasmid isolation and transformation experiments

Module- IV

Definition, scope, and importance of bioinformatics in modern biology. Introduction to databases: Definition, types, and organization. Overview of primary databases (NCBI, EMBL, DDBJ). Specialized databases: UniProt (protein), PDB (structure), KEGG (pathways), Ensembl (genomes). Introduction to NCBI Entrez, BLAST, and PubMed for data retrieval.

Practice: Database searches and sequence alignment exercises

Module- V

Types of alignments: Global vs. local alignment. Pairwise sequence alignment, Multiple sequence alignment (MSA): ClustalW, MUSCLE, Phylogenetic tree construction methods: Distance-based (UPGMA, Neighbor-Joining), character-based (Maximum Parsimony, Maximum Likelihood). Protein structure prediction: homology modeling, ab initio methods, Protein-ligand interactions, docking studies.

Practice: Molecular visualization and protein structure prediction

Suggested Readings:

1. Watson JD, Baker TA, Bell SP, Gann A, Levine M and Losick R (2008) Molecular Biology of the Gene, 7th edition, Cold Spring Harbour Lab. Press, Pearson Publication. (e-Book link: https://www.pdfdrive.com/molecular-biology-of-the-gene-

e158278674.html)

2. Bruce Alberts, Alexander Johnson, Julian Lewis, David Morgan, Martin Raff, Keith Roberts, Peter Walter (2015) Molecular Biology of the cell, 6th edition, Taylor and Francis Group.
   (e-Book link:https://www.pdfdrive.com/molecular-biology-of-the-cell-d184612905.html)
3. Principles and Practice of Medicine- by Davidson, S. S., J. MacLeod and C.R.W. Edwards,1991 Publisher Churchill Livingstone.
   (e-Book link: https://www.pdfdrive.com/davidsons-principles-and-practice-of-medicine- d186204495.html)
4. Sambrook J and Russell DW. (2001). Molecular Cloning: A Laboratory Manual. 4th Edition, Cold Spring Harbour Laboratory press.
   (e-Booklink: https://www.pdfdrive.com/search?q=Sambrook+J+and+Russell+DW.+%282001%29.+Moleculr+Cloning%3A+A+Laboratory+Manual.+4th+Edition&pagecount=&pubyear=&searchin=&m ore=true)
5. Geoffrey M. Cooper, Robert E. Hausman (2007). The Cell, A molecular approach. 4th ASM Press, Washington, D.C.
   (e-Book link: https://www.pdfdrive.com/the-cell-a-molecular-approach-e186369576.html)
6. B. Primrose and R.M. Twyman (2006) Principles of Gene Manipulation and Genomics 7th Edition. Blackwell Publishing.
   (e-Book link: https://www.pdfdrive.com/principles-of-gene-manipulation-and-genomics- e25845509.html)

Online Tutorial links:

1. DNA Decoded (coursera link: https://www.coursera.org/learn/dna-decoded) DNA Replication (Lecturio link: https://app.lecturio.com/#/course/s/8020)
2. Transcription (Lecturio link: https://app.lecturio.com/#/lecture/s/5990/35832)

HISTOPATHOLOGY AND CYTOLOGY

Subject Name	Code	Type	T + P + Pj	Credits
Histopathology and Cytology	CUTM4323	Theory + Practice	2+1+0	3

Course Objective:

- To introduce the organization and essential equipment of a histology laboratory
- To discuss various fixatives, including simple, compound, and special fixatives, used for preserving tissue elements.
- To demonstrate the use of instruments like tissue processors, microtomes, and tissue baths.
- To perform manual and automated techniques for tissue processing and cytology

Course Outcome:

After completion of the course, the students will be able to,

Cos	Statements	COs With POs and PSOs Mapping
CO1	Identify the essential equipment used in histopatho technology, the types of fixatives and stains.	PO1, PO10, PSO2
CO2	Understand the criteria for selecting decalcification agents and the components of various fixatives.	PO1, PO2, PO10, PSO2
CO3	Execute different staining techniques, including Periodic Acid Schiff staining, Hematoxylin and Eosin staining, and special stains, in enhancing the visibility of tissue structures	PO1, PO2, PO10, PSO2

CO4	Apply their knowledge to demonstrate the correct histo-technique for examining various types of tissues.	PO2, PO5, PO10, PSO2
CO5	Assess the importance of proper maintenance, labeling, and safety practices in a cytology laboratory.	PO5, PO8, PO11, PSO2

Course Outline:

Module- I

Organization of histology laboratory – Histological equipments, reception and recording of tissue specimens. Basic concepts about routine methods of examination of tissues, Collection and transportation of specimens for histological examination, fixation: Process, Various types of fixatives used in a routine histopathology laboratory- Simple fixatives, Compound fixatives, Special fixatives for demonstration of various tissue elements.

Practice: Care & maintenance of Histology equipments, Collection & transportation of specimens, Fixation

Module- II

Decalcification Criteria of a good decalcification agent, Technique of decalcification Followed with selection of tissue fixation, decalcification neutralization of acid and thorough washing. Various types of decalcifying fluids, Processing of various tissues for histological examination, Embedding, Schedule for manual or automatic Tissue processing, Components & principles of various types of a tissue processors.

Practice: Method of Decalcification, Embedding, manual or automatic tissue processings schedule.

Module- III

Periodic Acid Schiff Staining, Impregnation and Mountains, Commonly used mountains in histotechnology lab. General Staining Procedures (routine H&E stain, PAP stain and other special stain) for Paraffin Infiltrated and Embedded tissue, To perform & practice the manual & automated Haematoxylin and Eosin staining technique, To perform & practice the Mallory's Phosphotungstic Acid Haematoxylin (PTAH). Introduction of FNAC and its staining tech, museum technique, post

mertum technique.

Practice: Procedure for manual Staining and Automatic Staining Technique, FNAC technique, Museum technique (Hospital Visit), Post mortem technique (Hospital Visit).

Module- IV

Demonstration of instruments used for dissection Use of antiseptics, disinfectants and insecticides in a tissue processing laboratory Reception and labeling of histological specimens Preparation of various fixatives -Helly's fluid, Zenker's fluid, Bouin's fluid, Corney's fluid, 10% Neutral formalin, Formal saline, Formal acetic acid, Pereyn's fluid, prepare 70% alcohol from absolute alcohol. To perform embedding and casting of block.Tissue Processor, Microtomy, Honing and Stropping technique, Use of tissue floating bath, Use of incubator.

Practice: Preparation of various Fixatives, Labeling of Histological specimens, Embedding and Casting of block. Processing of tissue by manual and automated processor method. To demonstrate various part and types of microtome.

Module- V

Collection, preservation, fixation and processing of various cytological specimens. Preparation and quality control of various reagents and stains used in cytology. Cytology of female genital tract, urinary tract, gastrointestinal tract, respiratory tract, effusions and miscellaneous fluids. FNAC – method of aspiration, slide preparation, fixation and staining of smears. Automation in cytology.

Practice: PAP staining, H/E staining

Suggested Readings:

1. Color text book of histology by Gartner &Hiatt, publisher Elsevier
2. Netter's essential histology by William Ovalle, publisher Elsevier
3. Histology E-book by Barry Mitchell, publisher Elsevier
4. Textbook of Histology (color atlas) by Krishna Garg, Indira Bahl, Mohini kaul, publisher CBS
5. Textbook of Histology and a Practical Guide by JP Gunasegaran, PublisherElsevier
6. Textbook of Medical Laboratory Technology by Praful B Godkar, Publisher Bhalami

7. E book link- https://books.google.co.in/books?id=qWScAQAAQBAJ&printsec=frontcover&sourc e=gbs_ge_summary_r&cad=0#v=onepage&q&f=false
8. E book link- https://books.google.co.in/books?id=MrpEDwAAQBAJ&printsec=frontcover&sourc e=gbs_ge_ summary_r&cad=0#v=onepage&q&f=false
9. E book link- https://books.google.co.in/books?id=CERPDwAAQBAJ&printsec=frontcover&sourc e=gbs_ge_summary_r&cad=0#v=onepage&q&f=false

MINI PROJECT

Subject Name	Code	Type	T + P + Pj	Credits
Mini Project	CUTM1754	Project	0-0-2	2

Course Objective:

- To contribute to the advancement of knowledge in the field of microbiology by conducting original research or exploring innovative approaches
- To apply theoretical knowledge gained during the academic coursework to real-world optometry scenarios.
- To develop skills in data collection techniques, data analysis, and interpretation, which are essential for evidence-based practice.
- To present findings and results in a clear, concise, and professional manner.

Course Outcome:

After completion of the course, the students will be able to,

COs	Statements	COs with POs and PSOs Mapping
CO1	Identify health gaps specific to a community.	PO5, PO10, PO11, PSO3
CO2	Demonstrate critical thinking in solving health related issues.	PO5, PO7, PO12, PSO3
CO3	Evaluate case studies.	PO5, PO8, PO12, PSO3
CO4	Design and address a research problem.	PO6, PO8, PO12, PSO3
CO5	Understand the steps involved in data collection and questionnaire design	PO9, PO10, PO12, PSO3

Course Outline:

- The student is supposed to carry out project work in assistance with a mentor. The project should be relevant to the syllabus and should be qualitatively initiated towards fetching a research publication/ case study/ clinical study/ community service/ survey on successful completion within the stipulated time.
- Outcome: Research paper publication/ new idea generation/ case study/ clinical study/ community service/ survey.

PROJECT

Subject Name	Code	Type	T + P + Pj	Credits
Project	CUTM4339	Project	0-0-10	10

Course Objective:

- To contribute to the advancement of knowledge in the field of Medical Laboratory technology by conducting original research or exploring innovative approaches

- To apply theoretical knowledge gained during the academic coursework to real-world optometry scenarios.
- To develop skills in data collection techniques, data analysis, and interpretation, which are essential for evidence-based practice
- To present findings and results in a clear, concise, and professional manner.

Course Outcome:

After completion of the course, the students will be able to,

COs	**Statements**	**COs with POs and PSOs Mapping**
CO1	Identify health gaps specific to a community.	PO5, PO10, PO11, PSO3
CO2	Demonstrate critical thinking in solving health related issues.	PO5, PO7, PO12, PSO3
CO3	Evaluate case studies.	PO5, PO8, PO12, PSO3
CO4	Design and address a research problem.	PO6, PO8, PO12, PSO3
CO5	Understand the steps involved in data collection and questionnaire design	PO9, PO10, PO12, PSO3

Course Outline:

1. Antibacterial activity of sweet orange (citrus sinesis) on Staphylococcus aureus and Escherchia coli isolated from wound infected.
2. The incidence of Salmonella and Escherchia coli in livestock (Poultry) feeds
3. Microbial evaluation of milk from a dairy farm.
4. Gastroenteritis in primary school children (6-12yr) of specific locality.
5. Comparative analysis of microbial load of the main water production and water available to CUTM campus

INTERNSHIP

Subject Name	Code	Type	T + P + Pj	Credits
Internship	CUTM4340	Project	0-0-10	10

Course Objective:

- To gain hands-on clinical experience in conducting comprehensive diagnosis of the specimen.
- To become familiar with advanced instrumentation and technology used in the field of diagnosis
- To operate specialized diagnostic tools, imaging devices, and diagnostic instruments, enhancing their skills in evaluating health and providing accurate diagnosis.
- To develop effective patient interaction and communication skills

Course Outcome:

After completion of the course, the students will be able to,

COs	Statements	COs with POs and PSOs Mapping
CO1	Select relevant scientific literature.	PO1, PO8, PO12, PSO3
CO2	Execute appropriate data collection techniques and tools.	PO9, PO10, PO12, PSO3
CO3	Analyse data with appropriate statistical techniques.	PO5, PO9, PO12, PSO3
CO4	Design a research proposal.	PO6, PO8, PO12, PSO3
CO5	Integrate theoretical concepts and practical skills gained from their coursework to design and execute a research project	PO1, PO2, PO5, PO12, PSO1, PSO3

Course Outline:

Internship Thesis Guideline:

This Guideline is designed to provide students the knowledge and practice of public health research activity, to enable them to carry out researches and solve research related problems and to help them in writing thesis and defend their work. Upon successful completion of the course, the students shall be able to:

1. Search relevant scientific literature
2. Develop a research proposal
3. Employ appropriate data collection techniques and tools
4. Manage collected data
5. Analyze data with appropriate statistical techniques
6. Write thesis
7. Defend the findings

Proposal Development:

At the ending of second year (4th Semester), students individually consultation with designated faculties and extensive literature survey will develop research proposal during the initial 6 months period.

Data Collection/ Thesis Writing:

Students will carry out data collection, data management, data analysis, and thesis writing during the remaining period (Six Semester).

The Dissertation should have following format:

1. Title
2. Introduction
3. Materials and Methods
4. Results
5. Discussion
6. Conclusion
7. Recommendation
8. References

9. Appendix
10. Internship
11. Case record
12. Lab management and ethics
13. Evaluation – Guide (internal)
    a) Industries guide(external)
    b) University-project report/ Viva