CENTURION UNIVERSITY OF TECHNOLOGY AND MANAGEMENT, ODISHA

SCHOOL OF PARAMEDICS AND ALLIED HEALTH SCIENCES

MASTER OF SCIENCE IN APPLIED AND CLINICAL MICROBIOLOGY

(TWO YEARS PROGRAMME)

2024

SYLLABUS

M.Sc. in Applied and Clinical Microbiology

Preface: Clinical Microbiology is a branch of medical science focused on the prevention, diagnosis, and treatment of infectious diseases. It also explores the clinical applications of microorganisms to enhance health outcomes. The main pathogens responsible for infectious diseases include bacteria, fungi, parasites, viruses, and prions (infectious proteins).

A clinical microbiologist examines the characteristics of these pathogens, their transmission methods, and the mechanisms behind their infection and growth. This knowledge helps in refining treatment strategies. Often, medical microbiologists work as consultants to physicians, providing pathogen identification and recommending appropriate treatment options.

Scope:

The M.Sc. in Applied and Clinical Microbiology offers specialized education in the fields of medical and clinical microbiology. Graduates of this program can pursue various career opportunities, including:

- Specialized technologists or laboratory supervisors in hospital microbiology departments.
- Laboratory scientists working in biomedical and research institutions.
- Educators in training institutes for Medical Laboratory Technology or in graduate/postgraduate programs in microbiology and related fields.

Post-Graduates will be able to:

- Apply concepts, theories, and principles of laboratory science in practical settings.
- Plan and implement improvements in laboratory practices and healthcare delivery systems.
- Establish collaborative relationships across disciplines to enhance patient care and research.
- Demonstrate a commitment to lifelong learning and research for professional and personal development.
- Interpret and guide the development of cost-effective medical diagnostics for local needs.
- Manage and lead well-equipped and staffed clinical microbiology laboratories.
- Contribute as highly skilled professionals in the pharmaceutical or medical industry.
- Participate in supervised or team-based research in academic, industrial, or government settings.
- Exhibit advanced knowledge in Clinical Microbiology and Immunology, along with excellent teaching and communication skills.

- Display independent, critical, and analytical thinking, using their knowledge to benefit public health.
- Guide patient care and public education on the pathology, transmission, prevention, and control of infectious diseases.
- Become experts in managing patients with organ transplants, cancers, and immune deficiencies.
- Evaluate and offer recommendations to improve the effectiveness of national disease control programs.
- Develop the critical and analytical skills necessary for further specialized studies in microbiology or related fields.
- Address ethical challenges in their professional work and appreciate the significance of professional ethics in scientific communication and laboratory practices.
- Demonstrate competence in laboratory techniques, utilizing both basic and advanced tools for scientific inquiry.
- Communicate research findings effectively, both in writing and orally, to diverse audiences, including scientists and non-scientists.

Programme: M.Sc. in Applied and Clinical Microbiology

Duration: Two years full-time programme with 6 months internship in the last semester.
Eligibility: Any Science Graduate with Biology (Botany / Zoology) 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 M.Sc. in Applied and Clinical Microbiology degree will be awarded to candidates who complete the prescribed course of study over a minimum duration of two academic years, pass the examinations as per the relevant academic scheme, and successfully finish a mandatory 6-month internship in the final semester.

Upon successful completion of the two-year program, earning a minimum of 96 course credits, candidates will be awarded the degree of "Master of Science in Applied and Clinical Microbiology (M.Sc. CMB)" by Centurion University.

PROGRAMME 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

PROGRAMME SPECIFIC OUTCOMES (PSOs):

PSO	Outcomes
PSO1	To acquire advanced knowledge in the understanding of diagnostic methods used in clinical microbiology.
PSO2	To develop expertise in performing and interpreting advanced techniques used for identification and characterization of microorganisms.
PSO3	To gain research skills and knowledge in epidemiology, allowing to contribute through research projects and investigations.

PROGRAMME STRUCTURE

M Sc Applied and Clinical Microbiology

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	CUTM1711	General Microbiology	3+1+0	4
2	CUTM4291	Systemic Bacteriology	2+1+0	3
3	CUTM1717	Applied microbiology	2+1+0	3
4	CUTM4324	Medical Parasitology	2+1+0	3
5	CUTM4295	Immunology	3+1+0	4
6	CUTM4325	Medical Mycology and Virology	2+1+0	3
7	CUTM4298	Healthcare Associated Infections	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	**42**

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	PO1, PO2, PO5, PO10, PO11, PSO2

	assess the presence of pathogens in various body fluids.	
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 Diseases

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	PO1, PO5, PO11, PSO1, PSO3

	and tumor markers in clinical practice.	

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. Ebooklink- https://www.cartercenter.org/resources/pdfs/health/ephti/library/lecture_notes/health_science_students/medicalbiochemistry.pdf
7. Ebooklink- 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. Ebooklink- https://books.google.co.in/books?id=csPcDAAAQBAJ&printsec=frontcover&source =gbs_ge_s ummary _ r&cad=0#v=onepage&q&f=false
9. Ebooklink- 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

GENERAL MICROBIOLOGY

Subject Name	Code	Type	T + P + Pj	Credits
General Microbiology	CUTM1711	Theory+ Practice	3+1+0	4

Course Objective:

- To provide students with a comprehensive understanding of the diversity, classification, and characteristics of microorganisms
- To equip students with the skills necessary for sterilization, media preparation, and the cultivation of both aerobic and anaerobic microorganisms in a laboratory setting.
- To enable students to develop proficiency in the preparation of bacterial smears and performing various staining

techniques (e.g., Gram, Acid-fast, spore staining) to identify and differentiate microorganisms.

- To teach students about the nutritional requirements of microorganisms and the preparation of different culture media (e.g., selective, differential, enriched) used for microbial isolation and growth.

Course Outcome:

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

Cos	Statements	COs With POs and PSOs Mapping
CO1	Identify and define key historical milestones, recent trends, and developments in microbiology	PO1, PO6, PO12, PSO1
CO2	Summarize the different methods of sterilization, types of staining techniques used in bacteriology	PO1, PO10, PSO1, PSO2
CO3	Explain the principles of bacterial nutrition, cultivation methods for aerobes and anaerobes, bacterial growth curves, and the classification.	PO1, PO2, PO5, PSO1, PSO2
CO4	Appraise different staining technique in microbial identification.	PO2, PO10, PO11, PSO2
CO5	Evaluate the suitability of different types of media for various bacterial species, and critically assess the importance of biochemistry tests for bacterial identification	PO1, PO5, PO11, PSO2, PSO3

Course Outline:

Module-I

Structure & Function of Microbial Components: Bacterial cell wall, cell membrane, flagella, pili, capsule, gas vesicles, carboxysomes, magnetosomes, and phycobilisomes. Microbial Identification & Classification: Characterization and classification of microorganisms.

Practice: Preparation of bacterial smear and staining – Gram's, Acid-fast, Staining of bacterial spores, flagella, capsule, spirochetes

Module-II

Methods of sterilization: Physical methods – Dry heat, moist heat, radiation methods, filtration methods,

chemical methods and their application. Concept of containment facility. Different staining techniques used in bacteriology.

Practice: Demonstration the different type of Sterilization technique, Preparation of media, Cultivation of bacteria.

Module-III

Bacterial nutrition – Nutritional requirement of bacteria. Cultivation of aerobes and anaerobes, Reproduction in bacteria and spore formation.

Practice: Biochemical tests for identification of bacteria. Preservation of stock cultures of bacteria .

Module-IV

Bacterial growth curve and bacterial nutrition Media. Culture Media, Liquid and solid media, defined and synthetic media, routine laboratory media (basal, enriched, selective, enrichment, indicator, and transport media).

Practice: Preparation of different types of culture media. Determining the bacterial growth phases (lag, log, stationary, death) using optical density measurement.

Module-V

Recent Developments in Microbiology: Insights into modern trends and advancements. Advanced Staining & Identification Techniques: Application of advanced microbial identification methods. Industrial Applications of Microbiology: Overview of microbiology's role in industries.

Practice: Modern identification and characterization tools.

Suggested Readings:

1. Textbook of Microbiology- Ananthanarayan & Paniker (10th Ed)
2. Medical Microbiology-by Fritz H. Kayser et al
3. Medical Laboratory Technology by Kanai Lal Mukherjee, Publisher Tata McGrawHill
4. Microbiology (7th Ed)- by Prescott
5. Practical Book of Medical Microbiology by Satish Gupta, Publisher JaypeeBrothers
6. Medical Laboratory Manual for Tropical Countries Vol. I and II by Monica Cheesbrough
7. Essential Medical Microbiology- by Rajesh Bhatia (4th Ed)
8. Clinical laboratory methods and diagnosis by Gradwohls, 2000, Publisher Mosby
9. Medical laboratory science theory and practice, J Ochei and Kolhatkar, 2002, publisher TBS

SYSTEMIC BACTERIOLOGY

Subject Name	Code	Type	T + P + Pj	Credits
Systemic Bacteriology	CUTM4291	Theory+ Practice	2+1+0	3

Course Objective:

- To provide an in-depth understanding of various bacterial pathogens, their classification, and their role in human diseases.
- To equip students with advanced skills in identifying bacterial pathogens through both traditional and modern diagnostic methods.
- To apply theoretical knowledge in clinical scenarios, including the interpretation of diagnostic results and the management of bacterial infections.
- To learn opportunities in the basic principles of medical microbiology and infectious disease.

Course Outcome:

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

Cos	Statements	COs With POs and PSOs Mapping
CO1	Identify various types of bacteria from different groups based on their morphological characteristics.	PO1, PO11, PSO1
CO2	Understand the cultural characteristics, biochemical reactions, pathogenesis of diseases caused by specific bacteria	PO1, PO5, PSO1, PSO2
CO3	Explain the significance of culture techniques, media preparation, and identification methods in distinguishing different bacterial species	PO1, PO2, PO10, PO11, PSO1, PSO2
CO4	Apply their understanding to perform culture techniques and other diagnostic methods	PO1, PO10, PO11, PSO2
CO5	Evaluate the appropriateness of preventive and control measures, and synthesize their knowledge to perform accurate identification of bacterial	PO1, PO5, PO8, PO11, PSO2, PSO3

	species.	

Course Outline:

Module –I

Morphology, cultural characteristics, biochemical reaction, pathogenesis/disease caused & laboratory diagnosis, Prevention and Control: Aerobic Cocci : Micrococcus, Staphylococcus, Streptococcus and Anaerobic Cocci.

Practice: Culture techniques, culture media, identification of *Staphylococcus* species

Module –II

Morphology, cultural characteristics, biochemical reaction, pathogenesis/disease caused & laboratory diagnosis, Prevention and Control: Aerobic Gram-negative bacteria: Neisseria spp., Anaerobic Gram-negative bacteria.

Practice: Preparation of media for biochemical identification and uses.

Module –III

Morphology, cultural characteristics, biochemical reaction, pathogenesis/disease caused & laboratory diagnosis, Prevention and Control: Aerobic non-spore forming gram positive bacilli: Bacillus anthracis, Corynebacterium diphtheriae, Actinomyces spp., Nocardia spp. Tubercle bacilli and Hansen's bacilli. Anaerobic Gram-Positive Bacilli: *Bifidobacterium* spp, *Actinomyces* spp., *Clostridium* spp.

Practice: Identification of *Mycobacterium*. Media preparation for anaerobic bacteria, identification of common anaerobes.

Module –IV

Morphology, cultural characteristics, biochemical reaction, pathogenesis/disease caused & laboratory diagnosis, Prevention and Control: Aerobic Gram-Negative Bacilli (*Enterobacteriaceae* family): *Citrobacter, Edwardsiella, Enterobacter, Escherichia coli, Klebsiella, Morganella, Proteus, Porvidencia, Salmonella, Serratia, Shigella, Yersinia*

Practice: Culture methods and identification of *Escherichia coli*, *Klebsiella*, *Proteus* species

Module –V

Morphology, cultural characteristics, biochemical reaction, pathogenesis/disease caused & laboratory diagnosis, Prevention and Control: Aerobic and Miscellaneous Gram-Negative Bacilli: *Vibrio, Pseudomonas*, *Brucella*, *Bordetella*, *Haemophilus*, and *Mycoplasma* specimens.

Practice: Antibiotic sensitivity testing.

Suggested Readings

1. Textbook of Microbiology- Ananthanarayan & Paniker (10th Ed)
2. Microbiology (7th Ed)- by Prescott

3. Medical Microbiology- by David Greenwood et al (Elseviere)
4. Essential Medical Microbiology- by Rajesh Bhatia (4th Ed)
5. Medical Microbiology- by Kayser et al
6. The short text book of medical microbiology- by Satis Gupte (10th Ed)

APPLIED MICROBIOLOGY

Subject Name	Code	Type	T + P + Pj	Credits
Applied Microbiology	CUTM1717	Theory+ Practice	2+1+0	3

Course Objective:

- To gain insight into the beneficial and pathogenic roles of microorganisms in different body sites.
- To understand appropriate methods for collecting samples from various sites, including the skin, ear, and oral cavity.
- To learn to interpret diagnostic results, including antigen-antibody reactions and culture sensitivity testing.
- To recognize the impact of microbiology in community health, including the control of nosocomial infections and emerging microbial diseases.

Course Outcome:

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

Cos	Statements	COs With POs and PSOs Mapping
CO1	Understand the concepts of collection and transport of clinical specimens, and recall the preliminary processing steps of specimens.	PO1, PO11, PSO1
CO2	Discuss the basics of diagnostic microbiology approaches.	PO1, PO6, PO13, PSO1, PSO2
CO3	Interpret the results of antigen-antibody reactions,	PO1, PO2, PO5, PO10, PSO2

	pus culture and sensitivity, and apply their knowledge to demonstrate procedures like urine culture and sensitivity.	
CO4	Perform isolation procedures of specific microorganisms from various sources like oral cavity, skin, ear, etc.	PO1, PO10, PO11, PSO2
CO5	Evaluate the significance of microbiological analysis in milk, air, and water quality assessment.	PO1, PO5, PO8, PO11, PSO2, PSO3

Course Outline:

Module-I

The normal flora, collection and transport of clinical specimens, Collection and preliminary processing of specimens.

Practice: Isolation of *Streptococcus mutans* from oral cavity Procedure for sample collection from skin, ear.

Module -II

Diagnostic microbiology- an approach to laboratory diagnosis, Rapid and automation methods in diagnostic microbiology, Molecular techniques in microbiology, Serological and skin tests

Practice: Demonstration of antigen-antibody reaction Pus culture and sensitivity

Module – III

Microbiology in the service of human being, Community microbiology, Emerging and re-emerging Microbial disease, Nosocomial infections

Practice: Urine culture and sensitivity. Isolation of microorganism from spoiled fruit juice

Module -IV

Hospital and laboratory waste, Diagnostic virology, Emergency microbiology

Practice: Biomedical Waste Management

Module -V

Bacteriology of Milk, Air and Water

Practice: Isolation of microorganism from curd Isolation of microorganism from Air

Suggested Readings:

1. Medical Parasitology by RL Ichhpujani and Rajesh Bhatia, jaypee publisher
2. Short text book of medical microbiology by Satish gupta, Publisher Jaypee

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 immune technology.

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	PO1, PO2, PO11, PSO2

	Ag- Ab interaction.	
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, Quantitation 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.myuptodat e.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)

Medical Mycology and Virology

Subject Name	Code	Type	T + P + Pj	Credits
Medical Mycology and Virology	CUTM4325	Theory+ Practice	2+1+0	3

Course Objective:

- To provide students with a comprehensive understanding of the pathogenesis of fungal infections and viral diseases.
- To enable students to perform various laboratory techniques for the identification of fungal and viral pathogens.
- To equip students with the knowledge of different classes of antifungal and antiviral agents.
- To foster an understanding of emerging fungal and viral pathogens

Course Outcomes:

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

Cos	Statements	COs With POs and PSOs Mapping
CO1	Identify and describe the taxonomy, classification, morphology, structure, and pathogenesis of various fungal pathogens and viral agents	PO1, PO2, PO5, PSO1
CO2	Apply various fungal identification methods, including microscopy, staining techniques, and culture methods.	PO1, PO10, PO11, PSO2
CO3	Analyze the mechanisms of antifungal and antiviral drug action, resistance mechanisms in pathogens	PO1, PO5, PO2, PO10, PSO2
CO4	Design and develop protocols for the isolation, identification, and susceptibility testing of fungal pathogens	PO1, PO2, PO10, PSO2
CO5	Evaluate the effectiveness of antifungal therapy, assess the resistance patterns in fungal pathogens, and assess viral diagnostic results	PO1, PO5, PO8, PO11, PSO2, PSO3

Course Outline:

Module I:

Fungal taxonomy and classification, Morphology and structure of fungi, Growth, reproduction, Pathogenesis of fungal infections, Fungal Diseases (Mycoses), Superficial, cutaneous, subcutaneous, systemic, and opportunistic mycoses, Common fungal pathogens: Candida, Aspergillus, Cryptococcus, Histoplasma, Blastomyces, Coccidioides, Dermatophytes.

Practice: To prepare culture media used routinely in mycology. Perform all the staining techniques for identification of fungi.

Module II

Fungal Identification Methods, Microscopy (direct, staining techniques), Culture methods, Serological tests and antigen detection, Molecular methods (PCR, DNA sequencing), Antifungal Therapy: Antifungal agents: classes and mechanisms of action (azoles, polyenes, echinocandins), Antifungal susceptibility testing, Resistance mechanisms in fungi, Diagnosis, treatment, and prevention of mycoses.

Practice: Antifungal Sensitivity Test.

Module III

Emerging and Opportunistic Mycoses, Opportunistic Fungal Infections, Immunocompromised host and fungal infections (e.g., AIDS, transplant patients), Emerging fungi and drug resistance, Environmental and nosocomial mycoses.

Practice: Isolation and identification of fungus from clinical specimen.

Module IV

Viral Structure and Classification, Structure and composition of viruses, Viral replication cycles (lytic and lysogenic), Viral taxonomy: DNA and RNA viruses, enveloped and non-enveloped viruses, Viral Pathogenesis, Mechanisms of viral infections (attachment, entry, replication, assembly, release), Host immune response to viral infections, Viral latency, persistence, and oncogenesis

Module V

Medically Important Viruses, DNA viruses (Herpesviridae, Poxviridae, Hepadnaviridae, etc.), RNA viruses (Orthomyxoviridae, Coronaviridae, Retroviridae, Flaviviridae, etc.), Viral diseases: Influenza, Hepatitis, HIV/AIDS, Dengue, Zika, COVID-19, Viral Diagnostics, Virus isolation and culture methods, Serological assays (ELISA, neutralization tests), Molecular methods (PCR, RT-PCR, Next-Generation Sequencing)

Practice: Serological diagnosis of virus borne diseases: HBsAg, HIV

Suggested Readings:

1. Prescott, Harley, and Klein's Microbiology (Seventh Edition)- by Joanne M. Willey, Linda M. Sherwood, Christopher J. Woolverton. McGrawHill.
2. Microbiology An Introduction (10th Edition)- by Gerard J. Tortora, Berdell R. Funke, Christine.
3. Principles of Virology (4th Edition)- by Jane Flint, Glenn F. Rall, Vincent R. Racaniello, Anna Marie Skalka, Lynn W. Enquist. ASM Press, Washington, DC.
4. e-Book link: https://www.pdfdrive.com/principles-of-virology-d158020773.html
5. Virology: Principles and Applications- by John B. Carter and Venetia A. Saunders. Wiley Publishers. https://rgmaisyah.files.wordpress.com/2013/12/virology-principles- and-applications.pdf

HEALTHCARE ASSOCIATED INFECTIONS

Subject Name	Code	Type	T + P + Pj	Credits
Healtcare Associated Infections	CUTM4298	Theory+ Practice	3-1-0	4

Course Objective:

- To comprehend the structural organization of a hospital infection control program.
- To identify the major types of healthcare-associated infections, such as CAUTI, CLABSI, SSI, and VAP
- To gain knowledge of surveillance techniques for healthcare-associated infections, particularly device-associated infections, and calculate infection rates.
- To equip students with the ability to manage infection outbreaks and understand infection control measures during pandemics.

Course Outcome:

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

Cos	Statements	COs With POs and PSOs Mapping
CO1	Define key terms related to HAIs and describe the	PO1, PO6, PO8, PSO1

	structure and responsibilities of infection control programs	
CO2	Demonstrate proper hand hygiene techniques, including the steps of hand washing, PPE donning and doffing, and spillage management.	PO1, PO5, PO10, PO11, PSO2
CO3	Analyze the transmission routes of MDROs.	PO1, PO2, PO5, PO8, PSO1, PSO2
CO4	Assess different transmission methods and recommend appropriate infection control strategies in healthcare settings	PO1, PO5, PO6, PO8, PSO1
CO5	Evaluate the effectiveness of infection control practices during outbreaks.	PO1, PO5, PO8, PO9, PO11, PSO3

Course Outlines:

Module–I

Introduction – Definition, Epidemiological chain of HAI, Structural organization of HIC program

Composition, functions & responsibilities of HICC & ICT, Major healthcare associated infection types CAUTI, CLABSI, SSI, VAP Definition, organisms implicated, microbiological diagnosis & care bundles.

Practice: Air sampler for OT, Settle plate for OT

Module-II

Surveillance of HAI – Device associate infection calculation of rate Hand hygiene surveillance, Needle stick injury, & body fluid exposure surveillance. Standard precautions – hand hygiene Indications of hand hygiene & hand hygiene methods& hand hygiene audit. Standard precautions – PPE various equipment types donning doffing of

PPE kit.

Practice: Hand hygiene movements & steps, Donning &doffing of PPE kit & gloves

Module-III

Transmission based precautions Definition –Contact precautions, droplet precautions, airborne precautions, Agents, infection control measures. Infection control in special situations: Infection control in laboratory, OT, sterilization, disinfection, asepsis, cleaning & decontamination

CSSD: Objectives of CSSD Types of sterilizers & uses Sterilization control – Chemical & biological

Practice: Spillage management, Disinfection

Module-IV

Definition MDRO, MRSA, ESBL, Transmission & infection control measures for MDRO Identification of MRSA, VRE, ESBL Screening of health care workers for MDRO. Antimicrobial stewardship program.
Practice: MRSA detection, ESBL detection

Module-V

Needle stick injury (NSI), Prevention of needle stick injury, Post exposure Prophylaxis, Out break management, Identification & management, Infection control practices in pandemic situation, Waste management
Practice: Reporting of needle stick injury, Biomedical waste & visit to plant

Suggested Readings:

1. Shastri, Apurba S., & R., Deepashree. Essentials of Hospital Infection Control**.** Jaypee Brothers Medical Publishers, 2020.
2. Patawardhan, Nita. Hospital Associated Infections: Epidemiology, Prevention & Control. Jaypee Brothers Medical Publishers, 2010.

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, H2SO4)

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. Ebook 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. Ebook 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

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-Booklink: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=&pubye ar=&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&source=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&source=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&source=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 i.
- 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
Mini Project	CUTM4339	Project	0-0-10	10

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 i.
- To develop effective communication skills through oral presentations, written reports, and patient record

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