UNIVERSITY OF THE PUNJAB

NOTIFICATION

It is hereby notified that the Syndicate at its meeting held on 28-03-2025 has approved the recommendations of the Academic Council made at its meetings dated 27-01-2025 regarding Curriculum/Schemes of Studies/Syllabi/Courses of Reading of following Programs prepared in the light of HEC's Undergraduate Education Policy, 2023 w.e.f. Session, 2025 to be offered at the Department of Allied Health Sciences:-

i. BS in Medical Laboratory Technology (4-years Program)
ii. BS in Audiology (4-years Program)
iii. BS in Optometry & Vision Sciences (4-years Program)
iv. Doctor of Physiotherapy (5-years Program)

The Syllabi and Scheme of Studies of above Programs are enclosed herewith as Annexure-'A'.

Sd/-
Registrar

Admin. Block,
Quaid-i-Azam Campus,
Lahore.
No. D/3707 /Acad. **Dated: 14-5- /2025.**

Copy of the above is forwarded to the following for information and necessary action:-

1. Dean, Faculty of Health Sciences
2. Chairman, Department of Allied Health Sciences.
3. Controller of Examinations
4. Director, IT for placement at website
5. Secretary to the Vice-Chancellor
6. Private Secretary to the Registrar
7. Assistant Registrar (Statutes)
8. Admin. Officer (Syllabus)

14/5/25

Assistant Registrar (Academic)
for Registrar

Program Curriculum

Medical Laboratory Technology (MLT)

Department of Allied Health Sciences

University of the Punjab

Lahore.

Programme	Medical Laboratory Technology				
Duration	4-Years	**Semesters**	**8**	**Credit hours**	**142(103+39)**
Department	**Department of Allied Health Sciences**				
Faculty	**Faculty of Health Sciences**				

Department Introduction

The Department of Allied Health Sciences, established in 2017 within the umbrella of the Faculty of Health Sciences at the University of the Punjab, Lahore, offers comprehensive programs in Doctor of Physical Therapy (DPT) and various Allied Health Sciences. These programs are designed to provide students with a strong foundation in healthcare, preparing them for impactful careers in the ever-evolving medical field.

Department Vision

The vision of the Department of Allied Health Sciences is to be a leading institution in health education, fostering innovation and excellence in allied health practices. We aim to develop highly skilled, compassionate professionals who will contribute to improving healthcare outcomes through evidence-based practices, research, and holistic patient care. Our commitment is to empower students with the knowledge, critical thinking, and practical skills necessary to excel in diverse healthcare settings, promote health and well-being, and advance the field of allied health sciences globally.

Department Mission

The mission of the Department of Allied Health Sciences is to provide high-quality education and training in the fields of Doctor of Physical Therapy (DPT) and Allied Health Sciences. We are dedicated to fostering a supportive learning environment that emphasizes academic excellence, hands-on clinical experience, and research-driven innovation. Our goal is to equip students with the necessary skills, knowledge, and ethical values to become competent healthcare professionals. Through collaboration, community engagement, and a commitment to lifelong learning, we aim to improve healthcare delivery, promote wellness, and contribute to the advancement of the allied health professions.

Department Goals

The goals of the Department of Allied Health Sciences are:

1. **Academic Excellence**: To deliver high-quality, evidence-based education that prepares students for professional practice in allied health fields.
2. **Skilled Workforce Development**: To develop competent, compassionate, and ethical healthcare professionals through comprehensive programs in DPT and Allied Health Sciences.
3. **Clinical Competence**: To provide hands-on clinical training that enhances students' practical skills and enables them to deliver effective patient care.
4. **Research and Innovation**: To foster a culture of research and critical thinking, encouraging students and faculty to contribute to advancements in healthcare practices.
5. **Community Engagement**: To actively engage with local and global communities to address healthcare challenges, promote wellness, and improve patient outcomes.
6. **Lifelong Learning**: To cultivate an environment of continuous learning, professional development, and leadership within the allied health professions.
7. **Global Contribution**: To produce graduates who are prepared to meet the evolving healthcare needs and contribute to the global health workforce.

Program Introduction

The Medical Laboratory Technology program at the Department of Allied Health Sciences, University of the Punjab, Lahore, is designed to provide students with a strong foundation in laboratory practices, diagnostic techniques, and healthcare technology. The program covers various subjects, including clinical chemistry, microbiology, haematology, immunology, and molecular diagnostics. Through a combination of theoretical knowledge and hands-on training, students gain the necessary skills to

perform critical laboratory tests, analyze results, and contribute to accurate diagnosis and treatment planning. The program aims to produce highly skilled medical laboratory technologists who are vital in supporting healthcare teams and improving patient outcomes.

Program Objectives

The objectives of the Medical Laboratory Technology program are:

1. **Knowledge Acquisition**: To provide students with a strong theoretical foundation in medical laboratory technology, including clinical chemistry, microbiology, hematology, immunology, and molecular diagnostics.
2. **Practical Skill Development**: To equip students with hands-on experience in laboratory procedures, ensuring proficiency in performing diagnostic tests, analyzing results, and maintaining laboratory equipment.
3. **Critical Thinking and Problem-Solving**: To develop students' ability to interpret laboratory data, apply critical thinking in diagnostic scenarios, and contribute to accurate patient diagnosis and treatment plans.
4. **Ethical and Professional Values**: To instill a strong sense of ethical responsibility, professionalism, and patient confidentiality in students, preparing them to work effectively in healthcare settings.
5. **Collaboration and Communication**: To foster teamwork and communication skills, enabling students to work seamlessly with doctors, nurses, and other healthcare professionals in a clinical setting.
6. **Research and Innovation**: To encourage students to engage in research and stay updated with the latest advancements in medical laboratory technology, promoting continuous learning and innovation in the field.
7. **Health Service Delivery**: To prepare students to apply their expertise in supporting efficient healthcare service delivery, bridging the gap between doctors and patients, and contributing to improved patient care outcomes.

Market Need / Rationale of the Program

Market Need / Rationale of the Medical Laboratory Technology Program

The introduction of a **Medical Laboratory Technology (MLT)** program is vital in addressing the increasing demand for skilled healthcare professionals. This program is designed to provide students with the necessary knowledge and technical skills required for medical laboratories, which are essential components of the healthcare system. Below is a detailed market need assessment for this program, highlighting the factors that support its introduction.

1. Potential Students for the Program

A key aspect of determining the need for the MLT program is understanding the interests, career aspirations, and academic readiness of potential students.

Key Aspects to Consider:

- **Career Needs:** The healthcare industry is expanding globally, with increasing demand for diagnostic and analytical services. Students are often interested in medical careers but may prefer roles that do not require direct patient interaction. MLT offers an excellent opportunity to enter the healthcare field in roles such as clinical laboratory technologist, medical researcher, and laboratory supervisor.
- **Subject Interest:** Science-oriented students, particularly those with an interest in biology, chemistry, and health sciences, are likely to be interested in this program. The rising interest in healthcare careers has been amplified by the COVID-19 pandemic, which has highlighted the critical role of diagnostic testing.
- **Student Demographics:** Potential students for the MLT program may include high school graduates with an interest in health sciences, professionals looking to shift careers, or individuals seeking specialization within the healthcare sector.

2. Potential Employers

Employers in the healthcare sector, both public and private, will be key stakeholders in the success of the MLT program. Identifying their needs ensures that the program aligns with industry demands.

Key Aspects to Consider:

- **Required Skill Set:** Employers require MLT graduates to possess both technical laboratory skills (such as sample analysis, handling diagnostic equipment, and interpreting test results) and soft skills like attention to detail, critical thinking, and teamwork.
- **Industry Projections:** The medical laboratory field is expected to grow significantly in response to an aging population, advances in medical technologies, and the increased reliance on diagnostic testing. The World Health Organization (WHO) and other health bodies forecast increased demand for laboratory services due to the rise in chronic diseases, infections, and public health issues.
- **Employment Opportunities:** In both urban and rural settings, medical laboratories (hospitals, clinics, public health organizations, research centers) are in constant need of qualified laboratory technicians. Government hospitals, private clinics, NGOs, pharmaceutical companies, and research institutions represent significant job opportunities.
- **Current and Future Prospects:** With emerging fields such as genomics, molecular biology, and personalized medicine, MLT graduates will be well-positioned for career advancement and opportunities in cutting-edge medical research and diagnostics.

3. Academic Projections

To assess the viability of the MLT program, it is important to examine both national and international trends in similar academic offerings.

Key Aspects to Consider:

- **National and International Offerings:** Many universities and technical colleges worldwide offer medical laboratory technology programs, with growing enrolment as demand for healthcare professionals increases. Countries with well-established healthcare systems, such as the United States, Canada, Australia, and the UK, continue to invest in MLT/MLT training programs.
- **Program Trends:** Advances in laboratory technology, such as automation, molecular diagnostics, and artificial intelligence in healthcare, are influencing the curriculum. The rise of telemedicine and remote diagnostics also highlights the importance of medical laboratory professionals in future healthcare systems.
- **Program Comparisons:** Review existing MLT/MLT programs in the region and internationally. Evaluate their curriculum, industry partnerships, and student outcomes to ensure that the proposed program can offer a competitive and relevant education.

4. Faculty

A strong and experienced faculty is critical for delivering a high-quality MLT program that meets both academic standards and industry needs.

Key Aspects to Consider:

- **Faculty Credentials:** Faculty members should possess both advanced degrees in Biological Sciences, Medical Laboratory Technology or related fields.
- **Capacity and Resources:** The program requires qualified faculty who can teach laboratory techniques, diagnostic procedures, and specialized subjects such as microbiology, hematology, and molecular diagnostics. Faculty should also be involved in research and professional development.
- **Professional Development:** Faculty should have access to ongoing training to stay updated with advancements in laboratory technologies, as well as opportunities for collaboration with medical institutions and research organizations.

5. Physical Facilities

The success of the MLT program relies on having well-equipped physical resources to support both theoretical and practical training.

- **Lab Facilities:** The program must be supported by modern, well-equipped laboratories where students can gain hands-on experience in microbiology, hematology, clinical chemistry, and molecular biology. Laboratories should include diagnostic tools, microscopes, automated analyzers, and safety equipment.
- **Library Resources:** A comprehensive library with access to current textbooks, academic journals, and online databases (such as PubMed, Scopus, etc.) is necessary to support students'

learning.

- **Technology Infrastructure:** The program should incorporate digital tools such as lab simulation software, learning management systems (LMS), and access to industry-standard diagnostic platforms.

Conclusion

The introduction of the **Medical Laboratory Technology program** is a response to the increasing demand for qualified healthcare professionals, as well as the growth of the global healthcare industry. A strong labor market, evolving industry needs, academic trends, qualified faculty, and state-of-the-art facilities all point to the necessity and viability of this program. By providing students with the technical expertise and hands-on experience required in diagnostic labs, the program will fill a crucial gap in healthcare workforce development, offering students both career security and employers the skilled professionals they need.

Admission Eligibility Criteria

- 12 Years of Study completed
- Study Program/Subject F.Sc. Pre Medical or equivalent
- Entry Test

Categorization of Courses as per HEC Recommendation and Difference

Semester	Courses	Category(Credit Hours)					
		Core Courses	Basic Courses	Major Electives	Minor Electives	Any Other	Semester Load
1	7	1(0)	4(10)	1(3)	1(3)		16 (13+3)
2	8	1(1)	4(9)	2(6)	1(3)		19 (16+3)
3	8	1(0)	3(9)	3(9)	1(3)		21(16+5)
4	7	1(1)	2(4)	3(9)	1(3)		17 (14+3)
5	7	1(0)	0	5(15)	1(3)		18 (11+7)
6	7	1(1)	0	5(15)	1(3)		19 (14+5)
7	6	2(3)	0	3(9)	1(3)		15 (9+6)
8	7	2(4)	0	5(13)	0		17 (10+7)
PU	**57**	**10**	**32**	**79**	**21**		**142(103+39)**
HEC Guidelines		**6**	**32**	**≥72**	**≥12**		
Difference (HEC &) PU		**4**	**-**	**7**	**9**		

**Core: Compulsory, Basic: Foundation, Major Electives: Professional Minor Electives: Specialization*

Note: The course/column heads are customizable according to nature and level of the program.

Scheme of Studies

S. #.	Course Code	Title of the Course	Credit Hours
1.	GENG-101	Functional English	3(3+0)
2.	GISL-101 / GETH-101	Islamic Studies / Ethics (for Non-Muslims)	2(2+0)
3.	GICP-101	Ideology & Constitution of Pakistan	2(2+0)
4.	MLT-101	Biochemistry	3(2+1)
5.	MLT-102	Human Physiology	3(2+1)
6.	MLT-103	General Pathology	3(2+1)
7.	HQ-001	Tarjuma-e-Quran	0
8.	GQR-101	Quantitative Reasoning-I	3(3+0)
9.	MLT-104	Behavioral Sciences	2(2+0)
10.	MLT-105	Medical Sociology	2(2+0)
11.	MLT-106	Basic Anatomy	3(2+1)
12.	MLT-107	Fundamentals of MLT	3(2+1)
13.	MLT-108	General Microbiology	3(2+1)
14.	MLT-109	Pakistan Studies	2(2+0)
15.	HQ-002	Tarjuma-e-Quran	1
16.	GQR-202	Quantitative Reasoning-II	3(3+0)
17.	GENG-201	Expository Writing	3(3+0)
18.	GICT-201	Applications of ICT	3(2+1)
19.	MLT-201	Introduction to Pharmacology	3(2+1)
20.	MLT-202	Immunology & Serology	3(2+1)
21.	MLT-203	Cell Biology & Histopathology	3(2+1)
22.	MLT-204	Hematology	3(2+1)
23.	HQ-003	Tarjuma-e-Quran	0
24.	GENT-101	Entrepreneurship	2(2+0)
25.	GCCE-101	Civics and Community Engagement	2(2+0)
26.	MLT-205	Forensic Science	3(2+1)
27.	MLT-206	Molecular Biology	3(2+1)
28.	MLT-207	Human Genetics	3(3+0)
29.	MLT-208	Cytology & Cytotechnology	3(2+1)
30.	HQ-004	Tarjuma-e-Quran	1
31.	MLT-301	Medical virology	3(2+1)
32.	MLT-302	Clinical Bacteriology & Mycology	3(2+1)
33.	MLT-303	Biostatistics	3(2+1)
34.	MLT-304	Biomedical Instrumentation	3(2+1)
35.	MLT-305	Biosafety & Risk Management	3(3+0)
36.	MLT-306	Clinical Lab Practices	3(0+3)
37.	HQ-005	Tarjuma-e-Quran	0
38.	MLT-307	Epidemiology	3(3+0)
39.	MLT-308	Cytopathology & Endocrinology	3(2+1)
40.	MLT-309	Research Methodology & skill enhancement	3(2+1)
41.	MLT-310	Bioinformatics	3(2+1)
42.	MLT-311	Clinical parasitology	3(2+1)
43.	MLT-312	Chemical Pathology	3(2+1)
44.	HQ-006	Tarjuma-e-Quran	1
45.	MLT-401	Health Biotechnology	3(2+1)
46.	MLT-402	Immunohematology and Transfusion Medicine	3(2+1)
47.	MLT-403	Artificial Intelligence in Lab Sciences	3(2+1)
48.	MLT-404	QC/QA Management	3(3+0)
49.	MLT-405	Internship	3(0+3)

50.	HQ-007	Tarjuma-e-Quran	0
51.	MLT-406	Advanced Molecular Biology	3(2+1)
52.	MLT-407	Advanced Clinical Microbiology	3(2+1)
53.	MLT-408	Advanced Clinical Biochemistry	3(2+1)
54.	MLT-409	Advanced Clinical Histopathology	3(2+1)
55.	MLT-410	Capstone Project	3(0+3)
56.	MLT-411	Scientific Writings	1
57.	HQ-008	Tarjuma-e-Quran	1
Total Credit Hours			**142(103+39)**

Scheme of Studies / Semester-wise workload

#	Code	Course Title	Course Type	Prerequisite	Credit hours		Total
Semester I							
1.	GENG-101	Functional English	General		3(3+0)		
2.	GISL-101 / GETH-101	Islamic Studies / Ethics (for Non-Muslims)	General		2(2+0)		
3.	GICP-101	Ideology & Constitution of Pakistan	General		2(2+0)		
4.	MLT-101	Biochemistry	General		3(2+1)		Natural Sc.
5.	MLT-102	Human Physiology	Interdisciplinary		3(2+1)		
6.	MLT-103	General Pathology	Major		3(2+1)		
7.	HQ-001	Tarjuma-e-Quran	Compulsory		0		
Total Credit Hours							16 (13+3)
Semester II							
1.	GQR-101	Quantitative Reasoning-I	General		3(3+0)		
2.	MLT-104	Behavioral Sciences	General		2(2+0)		Art & Hum
3.	MLT-105	Medical Sociology	General		2(2+0)		Social Sci
4.	MLT-106	Basic Anatomy	Interdisciplinary		3(2+1)		
5	MLT-107	Fundamentals of MLT	Major		3(2+1)		
6.	MLT-108	General Microbiology	Major		3(2+1)		
7.	MLT-109	Pakistan Studies	General		2(2+0)		General
8.	HQ-002	Tarjuma-e-Quran	Compulsory		1		
Total Credit Hours							19 (16+3)
Semester III							
1.	GQR-202	Quantitative Reasoning-II	General		3(3+0)		
2.	GENG-201	Expository Writing	General		3(3+0)		
3.	GICT-201	Applications of ICT	General		3(2+1)		
4.	MLT-201	Introduction to Pharmacology	Interdisciplinary		3(2+1)		
5.	MLT-202	Immunology & Serology	Major		3(2+1)		
6.	MLT-203	Cell Biology & Histopathology	Major		3(2+1)		
7.	MLT-204	Hematology	Major		3(2+1)		
8.	HQ-003	Tarjuma-e-Quran	Compulsory		0		
Total Credit Hours							21(16+5)
Semester IV							
1.	GENT-101	Entrepreneurship	General		2(2+0)		Entrepreneur
2.	GCCE-101	Civics and Community Engagement	General		2(2+0)		Civics & CE

#	Code	Course Title	Course Type	Prerequisite	Credit hours		Total
3.	MLT-205	Forensic Science	Interdisciplinary		3(2+1)		
4.	MLT-206	Molecular Biology	Major		3(2+1)		
5.	MLT-207	Human Genetics	Major		3(3+0)		
6.	MLT-208	Cytology & Cytotechnology	Major		3(2+1)		
7.	HQ-004	Tarjuma-e-Quran	Compulsory		1		
Total Credit Hours							17 (14+3)
Semester V							
1.	MLT-301	Medical virology	Major		3(2+1)		
2.	MLT-302	Clinical Bacteriology & Mycology	Major		3(2+1)		
3.	MLT-303	Biostatistics	Interdisciplinary		3(2+1)		
4.	MLT-304	Biomedical Instrumentation	Major		3(2+1)		
5.	MLT-305	Biosafety & Risk Management	Major		3(3+0)		
6.	MLT-306	Clinical Lab Practices	Major		3(0+3)		
7.	HQ-005	Tarjuma-e-Quran	Compulsory		0		
Total Credit Hours							18 (11+7)
Semester VI							
1.	MLT-307	Epidemiology	Major		3(3+0)		
2.	MLT-308	Cytopathology & Endocrinology	Major		3(2+1)		
3.	MLT-309	Research Methodology & skill enhancement	Major		3(2+1)		
4.	MLT-310	Bioinformatics	Interdisciplinary		3(2+1)		
5.	MLT-311	Clinical parasitology	Major		3(2+1)		
6.	MLT-312	Chemical Pathology	Major		3(2+1)		
7.	HQ-006	Tarjuma-e-Quran	Compulsory		1		
Total Credit Hours							19 (14+5)
Semester VII							
1.	MLT-401	Health Biotechnology	Major		3(2+1)		
2.	MLT-402	Immunohematology and Transfusion Medicine	Major		3(2+1)		
3.	MLT-403	Artificial Intelligence in Lab Sciences	Interdisciplinary		3(2+1)		
4.	MLT-404	QC/QA Management	Major		3(3+0)		
5	MLT-405	Internship	Compulsory		3(0+3)		
6.	HQ-007	Tarjuma-e-Quran	Compulsory		0		
Total Credit Hours							15 (9+6)
Semester VIII							
1.	MLT-406	Advanced Molecular Biology	Major		3(2+1)		

#	Code	Course Title	Course Type	Prerequisite	Credit hours		Total
2.	MLT-407	Advanced Clinical Microbiology	Major		3(2+1)		
3.	MLT-408	Advanced Clinical Biochemistry	Major		3(2+1)		
4.	MLT-409	Advanced Clinical Histopathology	Major		3(2+1)		
5	MLT-410	Capstone Project	Compulsory		3(0+3)		
6.	MLT-411	Scientific Writings	Major		1		
7.	HQ-008	Tarjuma-e-Quran	Compulsory		1		
Total Credit Hours							17 (10+7)

1. Type of course may be core (compulsory), basic (foundation), major elective (professional), minor elective (specialization) etc.

Research Thesis / Project /Internship

Details (credit hours, semesters etc.)

- Internship (3 Credit Hours) in 7th Semester
- Capstone Project (3 Credit Hours) in Final Semester

Award of Degree

Degree awarding criteria stating:

As per PU undergraduate policy
Thesis /Project/Internship (Compulsory)
Any other requirement, e.g. Comprehensive examination(if applicable)

NOC from Professional Councils (if applicable)

The required NOC will be processed accordingly.

Faculty Strength

Degree	Area/Specialization	Total
PhD	1. Human Genetics 2. Molecular Biology 3. Biochemistry 4. Molecular Biology and Molecular Genetics	**5**
MPhil	1. Molecular Biology	**1**
Total		**6**

Present Student Teacher Ratio in the Department

Total Faculty	**6**	**Total Students**	**NA**	**Ratio**	**NA**

Initially Startup of the Program.

Course Outlines separately for each course

Department of Allied Health Sciences
Faculty of Health Sciences
University of the Punjab, Lahore

Course Outline

Programme	Medical Laboratory Technology	**Course Code**	**MLT-101**	**Credit Hours**	3(2+1)
Course Title	Biochemistry				

Course Introduction

Biochemistry is the study of the chemical substances and processes that occur in living organisms. It focuses on the structure, function, and role of biomolecules like proteins, carbohydrates, lipids, nucleic acids, and enzymes. Biochemists investigate the chemical reactions that drive biological functions, including the synthesis of biologically active molecules. The field also examines the structure and metabolism of essential compounds, helping to understand how these molecules contribute to life processes. Biochemistry applies physicochemical principles to study macromolecules within living systems, covering topics such as metabolic pathways, enzyme kinetics, and energy production. This discipline plays a key role in medicine, pharmacology, and nutrition, contributing to the development of new therapies, diagnostics, and dietary guidelines. By linking chemistry and biology, biochemistry provides insights into the molecular basis of life and its impact on health and disease.

Learning Outcomes

On the completion of the course, the students will:

- Understand the chemical substances and biochemical processes in living organisms.
- Describe the structure, function, and role of key biomolecules like proteins, carbohydrates, lipids, and nucleic acids.
- Apply physicochemical principles to study metabolic pathways and biological processes.
- Identify key metabolic pathways and explain their role in energy production.
- Explain enzyme function, kinetics, and regulation in biochemical reactions.
- Demonstrate proficiency in laboratory techniques for analyzing biomolecules.
- Understand molecular mechanisms of diseases and apply biochemistry in diagnosis and treatment.
- Understand the synthesis and breakdown of biologically active molecules.
- Apply biochemistry to nutrition, pharmacology, and clinical diagnostics in allied health sciences.
- Develop analytical and problem-solving skills for interpreting experimental data and real-world health scenarios.

Course Content (Theory)		**Assignments/Readings**
Week 1	Introduction to Biochemistry	Biochemistry Textbook
	pH and pH Scale (Acidity & Alkalinity); Acid-Base Regulation in the Body	Complete exercises on pH scale and buffers
Week 2	Body Buffers and Their Mechanism of Action	Read on body buffers, focus on bicarbonate buffer
	Biochemical Composition and Functions of the Cell; Movement of Materials Across the Cell	Read Chapter on Cellular Structures and Transport
Week 3	Carbohydrates: Biochemical Structure, Function, and Classification (Polysaccharides, Oligosaccharides, Monosaccharides)	Review carbohydrate structures
	Carbohydrate Digestion and Absorption	Solve carbohydrate digestion problems
Week 4	Glycolysis: Introduction, Transport of Glucose into the Cell	Read about glycolysis and glucose transport

	Glycolysis Reactions: Reduction of Pyruvate to Lactate; Energy Yield from Glycolysis	Complete glycolysis pathway exercises
Week 5	Regulation of Glycolysis	Study regulation mechanisms of glycolysis
	Alternate Fates of Pyruvate	Review metabolism of pyruvate and its fates
Week 6	Tricarboxylic Acid Cycle: Reactions of the TCA Cycle	Read about the TCA cycle
	Mechanism of Arsenic Poisoning; Energy Produced by the TCA Cycle	Solve questions on arsenic poisoning and TCA
Week 7	Regulation of the TCA Cycle	Review TCA cycle regulation factors
	Substrates for Gluconeogenesis, Reactions Unique to Gluconeogenesis	Read about gluconeogenesis
Week 8	Regulation of Gluconeogenesis; Glycogen Metabolism	Study glycogen metabolism pathways
	Glycogenesis, Glycogenolysis	Complete exercises on glycogenesis and glycogenolysis
Week 9	Regulation of Glycogenesis and Glycogenolysis	Review the role of hormones in glycogen metabolism
	Irreversible Oxidative Reactions, Reversible Non-Oxidative Reactions	Read about oxidative and non-oxidative reactions
Week 10	Uses of NADPH	Study NADPH functions and its role in metabolism
	Diseases Associated with Carbohydrate Metabolism	Research diseases like diabetes, glycogen storage disorders
Week 11	Amino Acids: Introduction, Structure, Function, and Classification	Review amino acid structures and classification
	Primary Structure of Proteins: Peptide Bond and Folding	Complete protein structure exercises
Week 12	Secondary Structure of Proteins: α-Helices and β-Sheets	Study protein secondary structure in detail
	Tertiary and Quaternary Structure of Proteins; Protein Misfolding	Read on protein folding and misfolding
Week 13	Globular Proteins	Solve exercises on globular proteins
	Globular Hemoproteins: Myoglobin and Hemoglobin	Study hemoglobin and myoglobin structure
Week 14	Structure and Function of Myoglobin, Hemoglobin; Binding of Oxygen to Myoglobin and Hemoglobin	Research oxygen binding kinetics
	Allosteric Effects; Bohr Effect	Review allosteric regulation and the Bohr effect
Week 15	Fibrous Proteins: Collagen and Elastin	Study structure and function of collagen and elastin
	Protein Digestion and Absorption	Solve problems on protein digestion
Week 16	Urea Cycle and Metabolism of Ammonia	Complete urea cycle pathway exercises
	Enzymes: Introduction, Nomenclature, and Properties of Enzymes	Study enzyme classification and properties

Course Content (Lab)		Assignments/Readings
Week 1	pH Determination of Different Solutions	Read Chapter on pH and Buffer Systems from the textbook.
Week 2	Qualitative Determination of Carbohydrates	Read about Carbohydrate Classification and Tests.
Week 3	Molisch's Test for Carbohydrates	Study the Molisch's Test mechanism and its role in identifying carbohydrates.
Week 4	Iodine Test for Starch	Review Iodine Test mechanism and its use for detecting polysaccharides.
Week 5	Benedict's Test for Reducing Sugars	Read about reducing sugars and their reaction with Benedict's reagent.
Week 6	Barfoed's Test for Monosaccharides	Study Barfoed's test for distinguishing monosaccharides from disaccharides.
Week 7	Seliwanoff's Test for Aldoses vs. Ketoses	Review Seliwanoff's reagent reaction with aldoses and ketoses.
Week 8	Osazone Test for Carbohydrates	Study Osazone formation and its role in identifying sugars.
Week 9	Qualitative Determination of Proteins	Study protein structure and tests for protein presence.
Week 10	Ninhydrin Test for Amino Acids and Proteins	Read about the Ninhydrin test for amino acids and proteins.
Week 11	Biuret Test for Proteins	Study the Biuret reagent and its application to peptide bonds.
Week 12	Heavy Metal Test for Proteins	Study the reactions of proteins with heavy metals and their significance.
Week 13	Heat Coagulation Test for Proteins	Review protein denaturation and coagulation upon heating.
Week 14	Helle's Test for Protein Detection	Study the Helle's test for protein detection in biological fluids.
Week 15	Saturation Test for Lipids and Proteins	Read about saturation and its application in biochemical assays.
Week 16	Quantitative Determination of Glucose in Blood by Glucose-Oxidase Method Quantitative Determination of Protein by Biuret Method	Review glucose metabolism and the glucose-oxidase method. Study the Biuret method and protein quantification protocols.
Textbooks and Reading Material		
• **Nelson, D. L., & Cox, M. M. (2024).** *Lehninger Principles of Biochemistry* (9th ed.). W.H. Freeman & Company. • **Berg, J. M., Tymoczko, J. L., & Stryer, L. (2024).** *Biochemistry* (9th ed.). W.H. Freeman & Company.		

- **Murray, R. K., Granner, D. K., Mayes, P. A., & Rodwell, V. W. (2024).** *Harper's Illustrated Biochemistry* (35th ed.). McGraw-Hill Education.
- Abali, E. E., Cline, S. D., Franklin, D. S., & Viselli, S. M. (2021). *Lippincott Illustrated Reviews: Biochemistry*. Lippincott Williams & Wilkins.
- Voet, D., Voet, J. G., & Pratt, C. W. (2018). *Voet's Principles of Biochemistry*. Wiley Global Education.
- Karp, G., Iwasa, J., & Marshall, W. (2018). *Karp's Cell Biology*. John Wiley & Sons.
- Berg, J. M., Tymoczko, J. L., Stryer, L. (2024). Biochemistry: Laboratory Manual (9th ed.). W.H. Freeman & Company.
- Devlin, T. M. (2024). Biochemistry Laboratory Manual (12th ed.). Elsevier.
- Nelson, D. L., Cox, M. M. (2024). Lehninger Principles of Biochemistry: Laboratory Manual (9th ed.). W.H. Freeman & Company.

Teaching Learning Strategies

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   Engage students with interactive presentations, discussions, and real-time corrections of writing and speaking errors.
2. **Collaborative Learning**
   Students will work in pairs or small groups to write essays, analyze readings, and give peer feedback on presentations.
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   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
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Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-102	Credit Hours	3(2+1)
Course Title	Human Physiology				

Course Introduction

The **Physiology** course provides an understanding of the human body's functions and processes, focusing on the mechanisms that maintain homeostasis. It covers key systems such as cardiovascular, respiratory, musculoskeletal, and nervous systems, emphasizing the relationship between structure and function. The course includes practical sessions to measure vital parameters like blood pressure, pulse rate, ECG, and others, allowing students to apply theoretical concepts. Designed for students in allied health sciences, this course equips learners with essential knowledge and hands-on skills, preparing them for careers in healthcare and medical fields by exploring normal physiological processes and disease-related changes.

Learning Outcomes

On the completion of the course, the students will:

- Understand the fundamental physiological processes that maintain homeostasis in the human body.
- Explain the structure-function relationship in major organ systems like the cardiovascular, respiratory, digestive, and musculoskeletal systems.
- Demonstrate the ability to measure and interpret physiological parameters such as blood pressure, pulse rate, ECG, and others.
- Identify normal and abnormal physiological processes in various body systems.
- Apply knowledge of human physiology to healthcare, clinical diagnostics, and treatment approaches.
- Develop practical skills through laboratory experiments and real-world physiological measurements.
- Critically analyze physiological data and apply it to health and disease scenarios.

Course Content (Theory)		Assignments/Readings
Week 1	Introduction to Human Physiology: Functional organization—structure and function relationship; Homeostasis, feedback mechanisms (negate ve & positive)	Read chapters on Homeostasis and Functional Organization from textbook.
	Integumentary System: Functions of skin, hair, glands, and nails; Body temperature regulation	Study the structure and functions of the skin, hair, and glands.
Week 2	Musculoskeletal System: Functions of bones and muscles; Characteristics of skeletal, smooth, and cardiac muscle	Review muscle types and their functions; muscle contraction mechanisms.
	Muscle Contraction: Muscle contraction & relaxation in response to action potentials; Aerobic vs anaerobic contraction	Read on muscle physiology and contraction types.
Week 3	Muscle Hypertrophy and Atrophy	Study muscle hypertrophy and atrophy mechanisms and factors.
	Blood: Composition of blood and plasma, functions, formed elements, stages of cell development	Review blood components, formation, and functions.
Week 4	Blood Grouping and Coagulation Mechanism	Study blood grouping and coagulation pathways.
	The Cardiovascular System: Functions of the heart; Electrical activity of the heart, origin of cardiac impulse	Review the heart's electrical activity and phases of the cardiac cycle.
Week 5	Phases of the Cardiac Cycle; Heart Sounds; Regulation of Heart Functions (Intrinsic & Extrinsic)	Study the cardiac cycle, heart sounds, and heart function regulation.
	Functions of Peripheral Circulation; Physiology of Circulation	Understand systemic and pulmonary circulation.
Week 6	Nervous Control of Blood Vessels; Regulation of Arterial Pressure	Read on the autonomic nervous system's role in vascular regulation.
	The Lymphatic System: Functions of tonsils, lymph nodes,	Study the lymphatic system and

	spleen, thymus	immune response.
Week 7	Immunity: Innate vs Adaptive immunity, antigens and antibodies, primary and secondary immune responses	Review immunity types, lymphocyte function, and immune responses.
	The Specialized Sense Organs: Eye—Physiology of sight, accommodation, optic nerve, and chiasma	Study the physiology of vision and related neural pathways.
Week 8	Ear—Functions of the inner, middle, and outer ear; Physiology of hearing and balance	Review ear structure and function, hearing, and balance mechanisms.
	Smell—Physiology of the Olfactory Nerve; Taste—Physiology of taste and speech	Study the physiology of smell, taste, and speech processes.
Week 9	Nervous System: Functions of the CNS, functional areas of the cerebral cortex	Review the organization and functions of the central nervous system.
	Brainstem, Diencephalon, Basal Nuclei, Limbic System, Cerebellum Functions	Study the parts of the brainstem and their roles in motor control.
Week 10	Functions of Cranial Nerves; Somatic Motor Nervous System and Autonomic Nervous System	Review cranial nerve functions and somatic vs autonomic nervous systems.
	Neurons, Neuroglial Cells, and Components; Resting Membrane Potential, Action Potential	Study neuronal function, synapses, and neuroglial roles.
Week 11	Synapse and Reflex Arc Function	Understand reflex arc pathways and neural transmission.
	Respiratory System: Functions, ventilation, lung volumes, gas exchange, rhythmic ventilation	Review respiratory mechanics and gas exchange in alveoli.
Week 12	Digestive System: Functions of digestive organs, salivary glands, and regulation of movements and secretions	Study the digestive process, from mouth to absorption in intestines.
	Physiology of Digestion, Absorption, and Transportation of Nutrients	Study the absorption and transportation of nutrients within the body.
Week 13	Genito-Urinary System: Urine production, movement, and regulation of urine concentration and volume	Review kidney function, fluid balance, and urine production.
	Body Fluid Compartments; Regulation of Extracellular Fluid Composition	Study fluid compartments and how the body regulates fluid balance.
Week 14	Regulation of Acid-Base Balance	Review how the body maintains pH balance through buffers and systems.
	Male Reproductive System: Spermatogenesis, reproductive glands, hormones, and regulation	Study the physiology of male reproductive system and hormonal regulation.
Week 15	Female Reproductive System: Ovulation, hormonal regulation	Review the female reproductive cycle, ovulation, and related hormones.
	Endocrine System: Hormones and their regulation	Study the function of hormones and their effects on bodily functions.
Week 16	Review of Human Physiology: Integration of organ systems and homeostasis	Study the overall integration of systems and regulation of homeostasis.
	Final Review and Discussion of Key Concepts	Prepare for final exam, review key concepts and physiological processes.

Course Content (Lab)		Assignments/Readings
Week 1	Determination of Human Pulse Rate	Read about pulse rate measurement techniques and factors influencing pulse.
Week 2	Determination of Blood Pressure (Auscultatory and Palpatory Methods)	Study the principles of blood pressure measurement and interpretation.
Week 3	The Effect of Exercise and Posture on Blood Pressure	Review the physiological effects of exercise and posture on blood pressure.
Week 4	Determination of Visual Acuity for Distant Vision	Study the anatomy of the eye and factors affecting visual acuity.
Week 5	Determination of Visual Acuity for Near Vision	Read on near vision assessment and common vision disorders.
Week 6	Study of Hemocytometer	Review the principles of using a hemocytometer for blood cell counting.
Week 7	Count the Total Number of RBCs/mm^3 of Your Own Blood	Study RBC counting techniques and normal ranges for blood cell counts.
Week 8	Examination of Cranial Nerves	Study the functions and assessments of cranial nerves.
Week 9	Use of the Microscope	Review microscope types, parts, and proper usage techniques.
Week 10	Blood Pressure Measurement	Study blood pressure measurement devices and techniques.
Week 11	Membrane Permeability Test	Review the concept of membrane permeability and factors affecting it.
Week 12	Phlebotomy: Techniques and Procedures	Study phlebotomy techniques and safety protocols.
Week 13	Measuring Bleeding Time (BT) and Clotting Time (CT)	Read about the physiological basis of BT and CT and their significance.
Week 14	Electrocardiogram (ECG)	Study ECG principles, electrode placement, and interpretation of waves.
Week 15	Prothrombin Time (PT) Measurement	Review the concept and clinical significance of Prothrombin Time testing.
Week 16	Activated Partial Thromboplastin Time (aPTT) Measurement	Study the role of aPTT in coagulation testing and its clinical applications.

Textbooks and Reading Material

- **Essentials of Anatomy and Physiology** (4th Edition), Authors: Valerie C. Seeley, Stephen W. Stephens, Philip Tate, Publisher: W.B. Saunders Company
- **Guyton and Hall Textbook of Medical Physiology** (14th Edition), Authors: John E. Hall, Arthur C. Guyton, Publisher: Elsevier
- **Human Physiology: An Integrated Approach** (9th Edition), Author: Dee Unglaub Silverthorn, Publisher: Pearson
- **Principles of Physiology** (7th Edition), Author: Michael L. Johnson Publisher: Elsevier
- **Boron & Boulpaep's Medical Physiology** (3rd Edition), Authors: Walter F. Boron, Emile L. Boulpaep, Publisher: Elsevier

Teaching Learning Strategies

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Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
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3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-103	Credit Hours	3(2+1)
Course Title	General Pathology				

Course Introduction

The **General Pathology** course provides an in-depth study of the fundamental principles behind disease processes in the human body. It focuses on how cellular and molecular abnormalities contribute to structural and functional changes that lead to various diseases. By integrating theoretical lectures, laboratory demonstrations, and case studies, students will develop a thorough understanding of the mechanisms involved in the development, progression, and outcomes of diseases. This course serves as a foundational component in understanding pathological processes, preparing students for further study in medical and health-related fields.

Learning Outcomes

On the completion of the course, the students will:

- Understand the fundamental principles and mechanisms of disease processes.
- Recognize the role of cellular and molecular abnormalities in disease development.
- Analyze the structural and functional changes that occur in various diseases.
- Identify the causes and risk factors associated with different pathological conditions.
- Apply knowledge of disease mechanisms to understand the progression and outcomes of various health conditions.
- Evaluate case studies to develop clinical reasoning skills in the context of pathology.
- Demonstrate proficiency in laboratory techniques used to study pathological processes.
- Understand the impact of pathological changes on organ systems and overall health.
- Integrate pathological knowledge with clinical practice for improved patient care and diagnosis.

Course Content (Theory)		Assignments/Readings
Week 1	Cellular Adaptation: Atrophy, Hypertrophy, Hyperplasia, Metaplasia, Aplasia	Review chapters on cellular adaptation from the textbook.
	Cellular Adaptation: Atrophy, Hypertrophy, Hyperplasia, Metaplasia, Aplasia	Case study discussion on pathological cellular changes.
Week 2	Cell Injury and Adaptation: Cell Injury (Reversible and Irreversible)	Read about types of cell injury in pathology textbook.
	Fatty Change, Pigmentation, Pathologic Calcification	Study the mechanisms of fatty change and calcification.
Week 3	Necrosis and Gangrene	Assignment on types of necrosis with case examples.
	Inflammation: Acute Inflammation Overview	Review acute inflammation in pathological processes.
Week 4	Inflammation: Vascular Changes	Read on the vascular changes during inflammation.
	Inflammation: Chemotaxis and Opsonization	Prepare a detailed report on chemotaxis and opsonization.
Week 5	Inflammation: Phagocytosis	Study the role of phagocytosis in inflammation.
	Inflammation: Cellular Components and Chemical Mediators	Quiz on chemical mediators and cellular components in inflammation.
Week 6	Inflammation: Exudates vs. Transudate	Read on the differences between exudates and transudates.
	Chronic Inflammation: Etiological Factors	Research on the causes of chronic inflammation.
Week 7	Chronic Inflammation: Granuloma Formation	Case study on granulomas and their

		formation.
	Chronic Inflammation: Granuloma	Assignment on chronic inflammation and granuloma pathology.
Week 8	Cell Repair and Wound Healing	Read about the process of cell repair in wound healing.
	Regeneration and Repair	Discuss the regenerative vs. repair processes.
Week 9	Healing: First Intention	Assignment on wound healing by first intention.
	Healing: Second Intention	Study the process of wound healing by second intention.
Week 10	Factors Affecting Healing	Review factors affecting healing such as infection, nutrition, and circulation.
	Complications of Wound Healing	Case study on complications like infection, dehiscence, etc.
Week 11	Hemodynamic Disorders: Edema, Hemorrhage	Reading on hemodynamic disorders in pathology.
	Hemodynamic Disorders: Thrombosis, Embolism, Infarction & Hyperemia	Review thrombosis, embolism, infarction and hyperemia.
Week 12	Shock: Definition and Classification	Research on the classification and causes of shock.
	Shock: Compensatory Mechanisms	Discuss compensatory mechanisms involved in shock.
Week 13	Consequences of Thrombosis	Assignment on the clinical consequences of thrombosis.
	Arterial vs. Venous Embolism	Study the differences between arterial and venous emboli.
Week 14	Neoplasia: Dysplasia and Neoplasia	Read on dysplasia and neoplasia, with examples.
	Benign vs. Malignant Neoplasms	Compare benign and malignant neoplasms in terms of growth patterns.
Week 15	Etiological Factors of Neoplasia	Research on common causes of neoplasia, including environmental and genetic factors.
	Metastasis: Modes of Metastasis	Study the different modes of metastasis.
Week 16	Review of General Pathology: Cellular Injury and Adaptation	Group discussion or presentation on case studies of cellular injury.
	Review of General Pathology: Inflammation, Healing, Shock, Neoplasia	Final assignment or exam covering all topics studied.
Course Content (Lab)		
Week 1	**Microscopy Techniques**: Introduction to various types of microscopes, proper usage, and maintenance.	Study basic principles of microscopy and microscope handling.
Week 2	**Routine Staining (H&E)**: Techniques of Hematoxylin and Eosin (H&E) staining for tissue analysis.	Review the H&E staining procedure and its application.
Week 3	**Identification of Inflammatory Cells**: Study of neutrophils, macrophages, lymphocytes, eosinophils, and basophils.	Read on types and functions of inflammatory cells.

Week 4	**Acute Inflammation**: Observation and demonstration of acute inflammatory response, including cellular changes.	Review the mechanisms and cellular events in acute inflammation.
Week 5	**Chronic Inflammation**: Demonstration of chronic inflammation and granulomatous reactions in tissue samples.	Study the pathophysiology of chronic inflammation.
Week 6	**Intracellular Accumulations**: Study of fatty change in liver, melanin pigmentation, and brown atrophy in heart tissue.	Review the causes and types of intracellular accumulations.
Week 7	**Amyloidosis**: Identification of amyloid deposits in tissues like kidney, spleen, and liver.	Study amyloidosis, its causes, and histological features.
Week 8	**Lung Abscess Formation**: Histopathological study of abscess formation in lung tissues.	Read about the formation and diagnosis of lung abscesses.
Week 9	**Granulation Tissue in Chronic Inflammation**: Study of granulation tissue in healing chronic inflammatory lesions.	Review the characteristics of chronic inflammation and healing.
Week 10	**Tuberculous Lymphadenitis**: Examination of tuberculous lesions in lymph nodes, focusing on histological changes.	Study tuberculosis and its effects on lymph nodes.
Week 11	**Necrosis and Its Types**: Study of coagulative, liquefactive, caseous, and fat necrosis with examples from various organs.	Review the different types of necrosis and their causes.
Week 12	**Coagulative Necrosis**: Focused study of coagulative necrosis in organs such as the heart and kidneys.	Study coagulative necrosis, its features, and causes.
Week 13	**Histopathological Techniques**: Introduction to tissue fixation, embedding, sectioning, and staining methods.	Review histological processing techniques.
Week 14	**Study of Inflammation**: Practical demonstration of acute and chronic inflammation in tissue slides.	Study the stages and types of inflammation in tissues.
Week 15	**Comparing Acute and Chronic Inflammation**: Comparative analysis of acute vs chronic inflammation in various organs.	Review key differences between acute and chronic inflammation.
Week 16	**Final Practical Exam and Review**: Assessment of the ability to identify and describe pathological changes in slides.	Review all course content and prepare for the final exam.

Textbooks and Reading Material

- Jain, P. K., Singh, Y. N., Gollapalli, R. P., & Singh, S. P. (2022). Advances in Signal Processing and Communication Engineering: Select Proceedings of ICASPACE 2021. Springer Nature.
- Kumar, V., Abbas, A. K., Aster, J., & Deyrup, A. T. (2020). Robbins Essential Pathology (E-book). Elsevier Health Sciences.
- Agarwal, A., Jeyarajah, S., McLatchie, G., Borley, N., Harries, R., & Weerakkody, R. (2022). Oxford Handbook of Clinical Surgery. Oxford University Press.
- Goljan, E. F. (2019). Rapid Review Pathology: Second South Asia Edition.Cai, G., & Adeniran, A. J. (2019). Rapid On-Site Evaluation (ROSE): A Practical Guide. Springer Nature.
- Mitchell, R. N., Kumar, V., Fausto, N., Abbas, A. K., & Aster, J. C. (2016). Pocket Companion to Robbins & Cotran Pathologic Basis of Disease (E-book). Elsevier Health Sciences.
- Majno, G., & Joris, I. (2018). Cells, Tissues, and Disease. Wiley-Blackwell.

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Programme	Medical Laboratory Technology	Course Code	MLT-104	Credit Hours	2 (2+0)
Course Title	Behavioral Sciences				

Course Introduction

Behavioural sciences in medicine explore the intersection between human behaviour and health, focusing on how psychological, social, and cultural factors influence well-being and illness. This field encompasses psychology, sociology, and psychiatry, aiming to understand patient behaviour, mental health, and the social determinants of health. By applying behavioural science principles, healthcare providers can improve patient care, enhance communication, and address mental health issues alongside physical conditions. Understanding these aspects allows for more effective treatment strategies, improved patient adherence, and the promotion of healthier lifestyles, ultimately leading to better health outcomes and a more holistic approach to medical practice.

Learning Outcomes

On the completion of the course, the students will:

- Identify and explain the impact of cultural and community contexts on health behaviours, beliefs, and outcomes, and demonstrate how physicians can effectively integrate this understanding into patient care.
- Gather a comprehensive and accurate patient history that fosters a therapeutic relationship, demonstrating self-awareness and reflective practice in the process.
- Use shared decision-making principles to clearly explain a patient's medical condition and treatment options, considering the patient's background, education, and belief systems.
- Provide patient-centered behavioural guidance, articulating the relevant theoretical model that underpins the chosen approach.
- Recognize the influence of social determinants of health on patient outcomes and integrate this knowledge into clinical decision-making and patient care.
- Acknowledge and report personal errors, analyze their potential causes, and develop a plan to minimize future risks.

Course Content (Theory)		Assignments/Readings
Week 1	**Introduction to Behavioral Sciences and its Importance in Health**: Overview of behavioral sciences and health care models	Introduction to Behavioral Sciences
	Bio-Psycho-Social Model of Health Care and the Systems Approach: Integration of biological, psychological, and social factors	Review article on the Bio-Psycho-Social model in health care systems
Week 2	**Normality Vs Abnormality**: Understanding the concepts of normal vs abnormal behavior in health contexts	Case study: Identify signs of normal and abnormal behaviors in medical practice
	Professionalism and Desirable Attitudes in Health Professionals: Ethical standards, communication, and empathy	Professionalism in Health Care
Week 3	**Life Cycle - Behavioral Aspects of Development through the Life Cycle**: Infancy and childhood behavior	Assignment: Behavioral development in infancy and childhood
	Life Cycle - Behavioral Aspects of Development: Adolescence and adulthood	Case study: Behavioral characteristics of adolescence and adulthood
Week 4	**Death and Dying and Bereavement**: Psychological aspects of death and grieving	Read article on Psychological Stages of Dying and prepare for class discussion
	Death and Dying: Coping with death, dying, and bereavement	Case discussion on coping mechanisms during bereavement

Week 5	**Biological Basis of Behavior**: Psychodynamic factors - Learning, Memory, and Thinking	Prepare summary of different learning theories and their application in health
	Psychological Basis of Behavior: Motivation, Personality, Intelligence, Emotions, and Stress	Assignment: Identify how stress impacts learning and memory in health professionals
Week 6	**Social Basis of Behavior**: Sociological aspects of health and illness (Social Class, Gender, Health Belief Model)	Read sociological perspectives on health beliefs and class differences in healthcare
	Social and Anthropological Basis of Behavior: Stigma, Sick Role, Ethnicity, and Groups	Group discussion: Impact of stigma and ethnicity on patient care
Week 7	**Anthropological Aspects of Health**: Cultural sensitivity in health assessment	Prepare for discussion on cultural differences in health assessment and healthcare delivery
	Health Disparity and Health Inequality: Exploring the gap in healthcare access and outcomes	Read article on health inequalities and prepare a reflection on its societal impact
Week 8	**Illness and Healthcare Professional Relationship**: Medical Communication	Role play: Doctor-patient communication skills and medical interview
	Non-Pharmacological Interventions: Counseling, therapies, and alternative approaches	Study the use of non-pharmacological interventions in clinical practice
Week 9	**Breaking Bad News**: Techniques and psychological reactions	Assignment: Write a reflection on techniques for delivering bad news in a healthcare setting
	Crisis Intervention: Approaches to managing medical crises and acute reactions	Read Chapter on Crisis Intervention in Healthcare
Week 10	**Coping with Disability**: Stress, anxiety, and self-help groups for disabled individuals	Prepare for class discussion on psychological reactions to disability
	Pain Management and Psychosocial Aspects of Disability: Understanding pain in a psychological context	Assignment: Analyze case studies involving psychosocial aspects of pain management
Week 11	**Doctor-Patient Relationship**: Psychological reactions in doctor-patient interactions	Role play: Exploring different models of doctor-patient relationships
	Treatment Adherence: Understanding the factors influencing patient adherence to treatment	Read and summarize article on treatment adherence and patient behavior
Week 12	**Psychological Reactions to Illness**: Emotional and psychological impacts of illness	Prepare a case study on psychological reactions to chronic illness
	Psychosocial Aspects of Disease and Illness: Impact on social life and mental health	Study the effects of chronic diseases on patients' psychosocial well-being
Week 13	**Psychosocial Aspects of Intellectual Disability**: Behavioral, emotional, and social factors	Assignment: Case study of intellectual disability in healthcare settings
	Mental Health and Behavioral Factors in Disease: Exploring mental health challenges in disease diagnosis	Discuss mental health aspects of chronic disease treatment and management
Week 14	**Models of Doctor-Patient Relationship**: Exploring different therapeutic approaches	Case discussion on models of doctor-patient relationships and treatment adherence

	Psychosocial Interventions: Non-medical approaches to treating illness	Prepare presentation on psychosocial interventions in chronic diseases
Week 15	**Psycho-trauma and PTSD**: Understanding trauma, stress responses, and PTSD in healthcare	Prepare a reflective essay on coping with PTSD in healthcare settings
	Psychological Reactions to Trauma: Medical trauma and the need for specialized care	Group discussion on psychological management of trauma and crisis situations in healthcare
Week 16	**Integration of Behavioral Science in Health Care**: Summary and review of psychosocial aspects of healthcare	Review all key concepts discussed in previous weeks
	Final Exam: Review and application of behavioral science in health	Final Exam covering course content

Textbooks and Reading Material

- Behavioral Science in Medicine, 2nd Ed. by Barbara Fadem (2012).
- Handbook of Behavioral Sciences, 3rd Ed. by M.H. Rana (2012).
- Integrating Behavioral Sciences in Healthcare, 2nd Ed. by Asma Humayun and Michel Herber (2011).
- Psychology and Sociology Applied to Medicine: An Illustrated Color Text, 3rd Ed. by Beth Alder (2004).

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Programme	Medical Laboratory Technology	Course Code	MLT-105	Credit Hours	2 (2+0)
Course Title	Medical Sociology				

Course Introduction

Medical Sociology explores the relationship between society and health. This course introduces students to the ways in which social, cultural, and economic factors influence the experience of health and illness. It covers the impact of societal structures and social roles on healthcare delivery, illness perceptions, and the behavior of healthcare professionals and patients. By studying these sociological aspects, students will gain a deeper understanding of how health is shaped by social forces and how health disparities emerge and persist.

Learning Outcomes

On the completion of the course, the students will:

- Understand the role of social factors in shaping health and illness.
- Analyze the influence of social institutions (e.g., family, education, healthcare systems) on individual and collective health.
- Examine health disparities, focusing on race, gender, class, and other social determinants.
- Learn about the social construction of illness and how cultural perceptions influence the experience of illness.
- Develop an understanding of the sociological aspects of healthcare delivery and professional practice.

Course Content (Theory)		Assignments/Readings
Week 1	**Evolution of Health and Healing**: Historical Development of Medical Practices and Knowledge	Historical Evolution of Health Practices
	Evolution of Healthcare Systems and Treatment Modalities: Overview of healthcare systems and their evolution	Article: The Development of Healthcare Systems Across Time
Week 2	**Body, Mind, Illness, and Environment**: Impact of Environmental Factors on Health and Disease	Read article on Environmental Influences on Health
	Interconnection between Physical and Mental Health: Understanding the mind-body connection in health and illness	Case study on mind-body interactions in chronic illness
Week 3	**Theories of Medical Sociology**: Overview of Medical Sociology Theories	Theories in Medical Sociology
	Research Methods in Medical Sociology: Qualitative and quantitative research approaches	Prepare summary of different research methodologies in medical sociology
Week 4	**Current Debates and Controversies in Medical Sociology**: Contemporary discussions in the field	Research paper on a current debate in medical sociology (e.g., Medicalization, health disparities)
	Overview of the Social Construction of Health and Illness: Exploring the social context of health perceptions	Read article: Social Construction of Illness and Health
Week 5	**Social, Environmental, and Occupational Factors in Health and Illness**: Impact of Socioeconomic Status on Health	Socioeconomic Status and Health
	Impact of Environment and Living Conditions on Health: Exploring environmental health risks	Assignment on Environmental Health and Policy
Week 6	**Occupational Hazards and Health Implications**: The impact of work-related factors on health	Case study on occupational health risks (e.g., exposure to chemicals, stress in healthcare professions)
	The Meaning of Health and Illness from the Patient's Perspective: Subjective experience of health and illness	Reflection paper on personal perceptions of illness from a patient's viewpoint

Week 7	**Cultural and Social Influences on Perception of Health and Illness**: How culture shapes the view of illness	Read on cultural differences in illness perception
	Patient Empowerment and Decision-Making in Healthcare: The role of patient choice in treatment decisions	Group discussion on Patient Empowerment in Medical Decision-Making
Week 8	**Historical Transformation of Health Professions**: Evolution of Healthcare Professions and Roles	Research paper on the history of medical professions and their evolving roles in healthcare
	Changes in Healthcare Delivery Systems: Shifts in healthcare systems and the role of professionals	Case study on the evolution of healthcare delivery in developed countries
Week 9	**Impact of Technological Advancements on Healthcare Professions**: Technology's effect on healthcare roles	Assignment on the impact of telemedicine and AI in healthcare professions
	Social and Cultural Factors Surrounding the Creation and Labeling of Diseases: Social construction of diseases	Read article: Social Construction of Disease and Illness
Week 10	**Cultural Interpretations and Stigmatization of Diseases**: Exploring cultural responses to disease and illness	Group project on cultural interpretations of mental illness and its stigma
	Medicalization and Pathologization of Behavior: Examining the medicalization of everyday behaviors	Article review on Medicalization of Society
Week 11	**Disparities in Health, Access to Healthcare, and the Healthcare Received**: Socioeconomic Disparities in Health	Health Disparities in Society
	Access Barriers to Healthcare Services: Exploring obstacles to healthcare access	Research paper: Barriers to Healthcare Access in Low-Income Communities
Week 12	**Quality Discrepancies in Healthcare Provision**: Addressing inequalities in healthcare quality	Case study on healthcare quality issues (e.g., in underserved communities)
	Organizational and Ethical Issues in Medicine: Rising costs and healthcare reforms	Assignment on Ethical Dilemmas in Healthcare Reforms
Week 13	**Rising Healthcare Costs and Technology**: The economic challenges in modern healthcare systems	Read article on the economics of healthcare and technology
	Healthcare Reforms and Ethical Considerations: The role of ethics in healthcare reform	Debate: Should healthcare be a universal right?
Week 14	**Patient Rights, Consent, and Ethical Dilemmas in Medicine**: Addressing patient rights in the medical field	Case study on Patient Consent in Medical Procedures
	Ethical Issues in Healthcare Technology: The role of technology in ethical decision-making in healthcare	Review of ethical issues arising from new medical technologies (e.g., AI, gene editing)
Week 15	**Contemporary Issues in Medical Sociology**: Integration of theory, research, and social practices in healthcare	Prepare presentation on the integration of sociological theories in current medical practices
	Future Directions in Medical Sociology: Discussing emerging trends and future challenges in the field	Group discussion: The future of healthcare in a sociological context
Week 16	**Review of Key Concepts in Medical Sociology**: Recap of the course material and essential takeaways	Review key concepts and prepare for final exam
	Final Exam: Comprehensive exam covering all topics discussed throughout the course	Final Exam
Textbooks and Reading Material		
• The Sociology of Health and Illness Critical Perspectives,11th Edition byPeter Conrad, Valerie Leiter Published: June 2023		

- Medical Sociology by William Cockerham, 15th Edition. B/W Illustrations Published September 30, 2021, by Routledge.
- A Sociology of Health by David Wainwright, 2008
- The Sociology of Health, Illness, and Health Care: A Critical Approach, 7th Edition by Rose Weitz, 2016.

Teaching Learning Strategies

1. **Interactive Lectures**
   Engage students with interactive presentations, discussions, and real-time corrections of writing and speaking errors.
2. **Collaborative Learning**
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3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%.
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-106	Credit Hours	3(2+1)
Course Title	Basic Anatomy				

Course Introduction

This course, **Basic Anatomy**, aims to provide students with a fundamental understanding of human anatomy, focusing on the structure of the human body and its systems. The course is designed to familiarize students with the major body structures, organs, and their functions. Students will also learn the relationship between anatomical structures and physiological processes, offering a solid foundation for further studies in health sciences and allied health fields.

Learning Outcomes

On the completion of the course, the students will:

- Gain a Fundamental Understanding of Human Anatomy: Develop knowledge of the structure and organization of the human body.
- Familiarize with Body Systems: Understand the structure and function of the major organ systems such as skeletal, muscular, circulatory, respiratory, digestive, and others.
- Master Anatomical Terminology: Learn and apply key anatomical terms related to body positions, directions, and planes.
- Explore the Relationship between Anatomy and Health: Recognize how anatomical knowledge is applied in diagnosing and treating health conditions in healthcare settings.
- Visualize the Human Body: Use visual aids such as models, diagrams, and 3D tools to understand and identify the body's structures.
- Understand the Levels of Biological Organization: Learn the levels of organization in the body, from cells to tissues, organs, and systems.
- Apply Knowledge to Health Sciences: Build a foundation for further studies in allied health fields by understanding how anatomy relates to physiology and patient care.

Course Content (Theory)		Assignments/Readings
Week 1	**Introduction to Basic Anatomy**: Overview of the course, significance of anatomy in health sciences.	Introduction to Anatomy and Its Importance in Health
	Anatomical Nomenclature: Anatomical terminology, body plan, and structure.	Read article: Fundamentals of Anatomical Nomenclature and Terminology
Week 2	**Life Span of a Human Being**: Developmental stages and anatomical changes over time.	Write a summary on Anatomical Changes Through the Human Life Span
	Structural and Functional Organization of the Body: Cells, tissues, organs, and systems.	Levels of Biological Organization
Week 3	**Terminology and Body Plan**: Understanding body orientation and anatomical planes.	Complete quiz on Anatomical Directions and Planes
	Systematic Anatomy: Overview of systematic anatomy and its relevance in healthcare.	Research paper on Systematic Anatomy and Its Role in Diagnosis
Week 4	**Basic Organization of the Body**: Introduction to body systems and their integration.	Prepare diagram: Basic Organization of the Human Body
	The Skin: Structure of hypodermis, dermis, epidermis; role of the skin in protection and regulation.	Read on Skin Structure and Function
Week 5	**Skin (Cont'd)**: Superficial fascia, deep fascia, structure of nails and hair, types of burns.	Case study on Types of Burns and Treatment
	The Musculoskeletal System: Overview of bones, muscles, and joints.	Write a report on Components of the Skeletal System
Week 6	**The Skeletal System**: Axial and appendicular skeleton, bone ossification, growth, remodeling, and repair.	Study guide: Axial and Appendicular Skeleton

	Main Features of the Skull: Skull features and their views. Shape and regions of the vertebral column.	Diagram: Skull Features and Vertebral Column
Week 7	**Fractures and Reduction Options**: Types of fractures and methods of reduction.	Group discussion: Fracture Types and Treatment
	Bones of the Upper and Lower Limb: Pectoral girdle, pelvic girdle, and their relation to limb movements.	Research paper: Bones of the Pectoral Girdle and Upper Limb
Week 8	**Types of Joints and Movements**: Various types of joints, joint movements, and classifications of synovial joints.	Assignment on Types of Joints and Joint Movements
	Connective Tissue and Cartilage: Components of the connective tissue matrix and cartilage.	Study on Connective Tissue and Cartilage Types
Week 9	**Muscles**: Structure and function of skeletal, smooth, and cardiac muscles.	Write a report on Types of Muscles and Their Functions
	Skeletal Muscle as Contractile Machinery: Sliding filament model of contraction.	Assignment: Sliding Filament Theory of Muscle Contraction
Week 10	**Origin, Insertion, and Types of Muscle Movements**: Understanding muscle action, synergists, antagonists, prime movers.	Case study on Muscle Movement and Function
	The Genito-Urinary System: Structures and organs of the urinary system, nephron structure, urine formation.	Read on Structure of the Urinary System and the Nephron
Week 11	**Urine Regulation**: Process of urine formation, regulation of urine concentration.	Research paper on Urine Formation and Regulation
	Formation of Sex Cells: Ovulation and spermatogenesis, reproductive system anatomy.	Assignment: Ovulation and Spermatogenesis Process
Week 12	**Male Reproductive System**: Structure and function of male reproductive organs.	Study guide on Male Reproductive Anatomy
	Female Reproductive System: Structure and function of female reproductive organs.	Write a report on Anatomy and Function of the Female Reproductive System
Week 13	**The Digestive System**: Structure of the digestive organs and their relationships with other organs.	Complete reading on Digestive System Anatomy and Its Functions
	Types of Digestion and Digestive Processes: Mechanical and chemical digestion.	Study: Types of Digestion and Digestive Processes
Week 14	**Secretory Glands in Digestion**: Liver, pancreas, and their exocrine and endocrine functions.	Research on The Role of Liver and Pancreas in Digestion
	Respiratory System: Anatomy of respiratory passages from nose to alveoli.	Diagram on Respiratory Passage Structure
Week 15	**Vocal Cords and Larynx**: Function of vocal cords, larynx, and voice production.	Write a report on The Role of the Larynx in Voice Production
	Respiratory and Conducting Zones: Different zones in the respiratory system.	Assignment on Respiratory Zones and Their Functions
Week 16	**The Nervous System**: Division of the nervous system, CNS, PNS, and autonomic nervous system.	Case study on Central and Peripheral Nervous System
	Special Senses: Olfactory system, hearing and balance, taste, vision, and touch.	Final exam review on Special Senses and Nervous System Pathways
Course Content (Lab)		**Assignments/Readings**
Week 1	**Labelling of Various Planes, Sections & Regions of the Human Body**: Identification and labelling exercises.	Read Chapter on Planes, Sections, and Regions of the Human Body
Week 2	**Skeletal System of the Human Body**: Study of human skeleton, labelling bones and understanding bone structure.	Review skeletal system and complete labelling exercises.
Week 3	**Identification of Bones**: Identification of compact, spongy, long, short, and sesamoid bones.	Assignment: Classification of Bone Types

Week 4	**Identification of Various Types of Muscles**: Label and identify different muscle types: skeletal, smooth, and cardiac.	Study muscle types and complete muscle identification worksheets.
Week 5	**Identification of Various Organs of the Gastrointestinal System**: Label and identify organs of digestion.	Read on Anatomy of the Gastrointestinal System
Week 6	**Labelling of Anatomical and Functional Regions of the Nervous System**: Identification of brain regions and spinal cord.	Review the nervous system anatomy and complete labelling exercises on brain regions and functional areas.
Week 7	**Drawing and Labelling of Structures of the Genito-Urinary Tract System**: Study of male and female reproductive organs and urinary tract.	Complete diagram labelling on Genito-Urinary System
Week 8	**Differentiation Between Arteries, Veins, and Capillaries**: Visual identification and functional differentiation.	Read on Difference Between Arteries, Veins, and Capillaries
Week 9	**Demonstration of Structures on Models**: Explore anatomical models of human systems (skeletal, muscular, etc.).	Practical workbook on Exploring Body Models
Week 10	**Demonstration of Specimens**: Examination of preserved anatomical specimens to understand real human anatomy.	Assignment: Analysis of Specimen Structures
Week 11	**Spottings**: Identifying and labelling anatomical structures on prepared slides or models.	Review spotting guide for human anatomy structures.
Week 12	**Histology Slides**: Study of tissue slides to identify types of tissues in various organs.	Read on Histology and Tissue Identification
Week 13	**X-Ray Identification**: Interpretation and identification of anatomical structures from X-ray images.	Assignment: Identifying Bones and Joints from X-rays
Week 14	**Demonstration of Joint Movements**: Observation and analysis of joint movements on models or volunteers.	Write a report on Types of Joint Movements and Their Functions
Week 15	**Practical on Muscular Contractions**: Hands-on demonstration of muscle contractions and types of movements.	Study on Muscle Contraction Mechanism and Types
Week 16	**Final Practical Review**: Comprehensive review of all anatomical structures covered through models, specimens, and slides.	Final practical exam review: Comprehensive Study of Human Anatomy

Textbooks and Reading Material

- Singh, V. (2022). *General Anatomy- with Systemic Anatomy, Radiological Anatomy, Medical Genetics - E-book*. Elsevier Health Sciences.
- Drake, R. L., Vogl, A. W., & Mitchell, A. W. (2022). *Gray's Basic Anatomy - E-book*. Elsevier Health Sciences.
- Kay, S., Wilks, D., & McCombe, D. (2020). *Oxford Textbook of Plastic and Reconstructive Surgery and Anatomy*. Oxford University Press.
- Spratt, J. D., Salkowski, L. R., Loukas, M., Weir, J., Turmezei, T., & Abrahams, P. H. (2020). *Weir & Abrahams' Imaging Atlas of Human Anatomy*. Elsevier.
- Siddiqui, L. (2019). *General Anatomy*.
- Garg, K. (2019). *BD Chaurasia's Handbook of General Anatomy*. CBS Publishers & Distributors Pvt, India.
- Snell, R. S. (2018). *Snell's Clinical Anatomy*. Wolters Kluwer India Pvt.

Teaching Learning Strategies

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Use case studies to explore real-life examples of communication in business, academic, and casual settings.

4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

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1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
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3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-107	Credit Hours	3(2+1)
Course Title	Fundamental of Medical Laboratory Technology (MLT)				

Course Introduction

The **Fundamentals of Medical Laboratory Technology (MLT)** course provides an introduction to the essential concepts, principles, and practices involved in Medical Laboratory Technology. This course is designed to familiarize students with the core functions of medical laboratory technology, its role in healthcare, and the importance of accurate laboratory testing in the diagnosis, treatment, and prevention of diseases.

The course will cover the structure and function of various laboratory departments, techniques used in clinical diagnostics, and the necessary skills and knowledge for conducting laboratory tests. Students will gain an understanding of the laboratory's role in patient care, quality assurance, safety procedures, and ethical standards.

Learning Outcomes

On the completion of the course, the students will:

- To provide students with an understanding of the basic principles and techniques used in medical laboratory technology.
- To familiarize students with the role of medical laboratory testing in disease diagnosis, treatment, and prevention.
- To develop competency in laboratory safety, quality control, and ethical practices.
- To equip students with foundational knowledge to pursue more specialized training in laboratory science.

Course Content (Theory)		Assignments/Readings
Week 1	**Introduction to Basic Laboratory Principles**: Overview of laboratory practices, importance, and roles.	Introduction to Medical Laboratory Technology
	Code of Conduct for Medical Laboratory Personnel: Ethical standards and professional responsibilities.	Read the Code of Ethics for Laboratory Professionals
Week 2	**Organization of Clinical Laboratories**: Structure, workflow, and departments in a medical laboratory.	Review Organization and Management of Clinical Laboratories
	Role of Medical Laboratory Technologists and Technicians: Responsibilities and career opportunities.	Read on Roles and Responsibilities of MLT Technologists and Technicians
Week 3	**Laboratory Safety Measures**: Standard precautions, infection control, and safety protocols.	Read Chapter on Laboratory Safety and Risk Management
	Medical Laboratory Professionalism: Characteristics of professionalism in laboratory workers.	Assignment: Write on Professionalism in the Medical Laboratory Setting
Week 4	**Code of Conduct and Ethical Considerations**: Guidelines for ethical behavior and patient confidentiality.	Read on Ethical Practices in Laboratory Medicine
	Communication Between Physician and Lab Technician: Importance of effective communication in patient care.	Assignment: Effective Communication Strategies for Lab Technicians
Week 5	**Common Glassware in Clinical Laboratory**: Types of glassware used and their functions.	Review Common Laboratory Glassware
	Cleaning, Care, and Maintenance of Glassware: Proper techniques for maintaining laboratory glassware.	Practical Guide on Cleaning and Maintaining Laboratory Glassware
Week 6	**Calibration of Pipettes and Volumetric Apparatus**: Principles and procedures for calibration.	Read on Calibration and Accuracy in Laboratory Instruments
	Introduction to Laboratory Instruments: Overview of key instruments used in clinical diagnostics.	Study on Laboratory Instrumentation and Techniques

Week 7	**Microscopes**: Principles, parts, use, care, and maintenance of light microscopes.	Read Chapter on Microscopy: History, Principles, and Applications
	Types of Microscopes: Classification and uses of various types of microscopes.	Assignment on Microscope Types and Their Applications in Clinical Labs
Week 8	**Nature of Light**: Concepts of amplitude, wavelength, phase, color, and brightness perception.	Read on Light, Refraction, and Image Formation
	Refraction and Image Formation in Microscopy: How light interacts with lenses to form clear images.	Study material on Refraction and Image Formation
Week 9	**Centrifuge**: Principles, operation, and uses of centrifuges in clinical labs.	Review on Centrifugation Techniques and Applications
	Water Bath: Uses and care of water bath apparatus in laboratory settings.	Read on Water Bath Techniques and Applications in Labs
Week 10	**Refrigerators and Storage Equipment**: Importance of temperature-controlled storage in labs.	Review Laboratory Storage Techniques
	Autoclave and Sterilization Techniques: Operation, care, and importance of autoclaving for sterilization.	Assignment on Autoclaving and Sterilization in Medical Laboratories
Week 11	**Hot Air Oven and Other Dry Heat Sterilizers**: Role and care in the sterilization process.	Read Sterilization Methods: Hot Air Oven vs Autoclave
	Mixer and Other Laboratory Apparatus: Functions and use of laboratory mixers.	Study on Laboratory Mixers and Their Applications in Clinical Labs
Week 12	**Water Distillation Apparatus**: Importance of distilled water in medical laboratory testing.	Review Distillation and Its Role in Clinical Laboratories
	General Approach to Specimen Collection, Transport, and Disposal: Best practices and standards.	Read Chapter on Specimen Collection and Handling Procedures
Week 13	**Anticoagulants**: Types of anticoagulants and their use in laboratory testing.	Study material on Anticoagulants in Laboratory Diagnostics
	EDTA and Other Anticoagulants: Detailed study of EDTA, oxalate, and citrate use in blood collection tubes.	Assignment on Types and Functions of Anticoagulants in Medical Testing
Week 14	**Dipotassium Salts of EDTA and Double Oxalate**: Comparison and usage in lab tests.	Review material on Anticoagulants: EDTA, Citrate, and Oxalate
	Single Oxalate and Sodium Fluoride: Study of their uses in clinical settings.	Study on Anticoagulants for Specific Blood Tests
Week 15	**Review of Laboratory Equipment and Instrumentation**: Recap of all key lab equipment discussed.	Comprehensive Review on Medical Laboratory Instruments and Their Uses
	Review of Laboratory Safety and Quality Control Measures: Reinforcement of laboratory safety protocols.	Assignment on Lab Safety Protocols and Best Practices
Week 16	**Final Review of Laboratory Techniques and Principles**: Recap of all laboratory techniques learned.	Final revision for the practical exam: Comprehensive Laboratory Techniques
	Final Assessment and Evaluation: Comprehensive theoretical exam based on course content.	Final Exam based on Fundamentals of Medical Laboratory Technology
Course Content (Lab)		**Assignments/Readings**
Week 1	**Handling of Microscope**: Familiarization with the light microscope, its parts, use, and maintenance.	Read the Microscope User Manual and Principles of Light Microscopy
Week 2	**Handling of Centrifuge**: Proper usage of a centrifuge, types of centrifugation, and safety measures.	Read on Centrifugation Techniques in Medical Laboratories
Week 3	**Handling of Water Bath**: Proper use, temperature setting, and maintenance of water bath equipment.	Study Water Bath Procedures and Safety

Week 4	**Handling of Refrigerators**: Correct usage for specimen storage, temperature monitoring, and maintenance.	Read Storage and Handling of Biological Specimens in Clinical Laboratories
Week 5	**Handling of Autoclave**: Operation, sterilization principles, and maintenance of autoclaving equipment.	Assignment: Autoclaving Procedures and Applications
Week 6	**Handling of Hot Air Oven**: Understanding dry heat sterilization and safe operation of hot air ovens.	Review Dry Heat Sterilization and Hot Air Oven Use in Laboratories
Week 7	**Handling of Mixer**: Usage of laboratory mixers for preparing solutions, suspensions, etc.	Read Laboratory Mixers and Their Applications in Clinical Settings
Week 8	**Handling of Water Distillation Apparatus**: Setting up and maintaining water distillation units.	Assignment on Water Distillation and Its Importance in Medical Laboratories
Week 9	**Calibration of Pipettes**: Techniques for calibrating single-channel and multi-channel pipettes.	Read Pipette Calibration Techniques and Procedures
Week 10	**Calibration of Volumetric Apparatus**: Principles of calibrating burettes, flasks, and graduated cylinders.	Practical Guide: Volumetric Apparatus Calibration in Clinical Laboratories
Week 11	**Advanced Handling of Microscopes**: Use of oil immersion, adjusting light intensity, and focusing techniques.	Study Advanced Microscopy Techniques in Medical Labs
Week 12	**Advanced Centrifugation Techniques**: Using different types of rotors and adjusting speed and time settings.	Review on Centrifuge Rotors and Their Applications in Clinical Labs
Week 13	**Refrigerator and Freezer Storage**: Demonstrating proper storage techniques for sensitive laboratory samples.	Read on Proper Temperature Management for Biological Specimens
Week 14	**Autoclave Safety and Maintenance**: Regular checks, cleaning, and sterilization cycle demonstration.	Assignment on Autoclave Safety Protocols and Equipment Maintenance
Week 15	**Practical Use of Hot Air Oven**: Sterilizing laboratory tools and materials, and checking for sterilization effectiveness.	Study material on Principles of Hot Air Sterilization and Applications in Medical Laboratories
Week 16	**Final Practical Assessment**: Combined assessment of all equipment and techniques covered in the course.	Review all practical work and readings. Prepare for Practical Skills Assessment in Medical Laboratory Technology

Textbooks and Reading Material

- Essentials of Medical Laboratory Technology, Author: S. K. Joshi, Edition: 4th Edition (2024)
- Clinical Laboratory Science: The Basics and Routine Techniques, Author: Mary Louise Turgeon, Edition: 7th Edition (2024)
- Medical Laboratory Technology: Principles and Practice, Author: K. S. P. Sastry, Edition: Latest Edition (2024)
- Cheesbrough M. District laboratory practice in tropical countries. Cambridge university press; 2006, Part I & II.
- Ravel, R., Clinical laboratory medicine: clinical applications of laboratory data. Mosby Elsevier 6th Edition1995.

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Programme	Medical Laboratory Technology	Course Code	MLT-108	Credit Hours	3(2+1)
Course Title	General Microbiology				

Course Introduction

The focus of this course is to provide students with comprehensive knowledge and practical skills in the field of general microbiology. It is designed to equip students with the foundational understanding of microorganisms, their behavior, and their role in both health and disease. Through a combination of theoretical learning and hands-on practical experience, the course aims to develop laboratory professionals who possess the necessary expertise to conduct diagnostic procedures, perform research, and contribute to microbiological advancements at internationally recognized standards. By the end of the course, students will be well-prepared to engage in microbiological laboratory practices and to contribute meaningfully to the field of microbiology in clinical, industrial, and research environments.

Learning Outcomes

On the completion of the course, the students will:

- Demonstrate the ability to identify and classify microorganisms based on their structure, morphology, biochemical properties, and genetic characteristics.
- Develop proficiency in essential microbiological techniques such as culturing, staining, and biochemical testing to study microorganisms in a laboratory setting.
- Explain the role of microorganisms in human health, including the mechanisms of infection, pathogenicity, and their relationship with the immune system.
- Apply aseptic techniques and follow proper safety protocols to prevent contamination and ensure the safety of laboratory environments.
- Perform microbiological diagnostic procedures and engage in basic research to investigate microbial phenomena, supporting evidence-based conclusions in clinical and laboratory settings.

	Course Content (Theory)	Assignments/Readings
Week 1	Fundamentals of microbiology: Introduction to microorganisms and their place in the living world.	General Microbiology Textbook.
	History of microbiology: Key discoveries and historical development.	Assignment: Write a short essay on the discovery of microorganisms.
Week 2	Differentiation between eukaryotic and prokaryotic cells.	Reading: Chapter on prokaryotic vs eukaryotic cells.
	Structure and function of prokaryotic and eukaryotic cells.	Assignment: Compare and contrast prokaryotic and eukaryotic cells in a tabular format.
Week 3	Microscopy: Principles of light microscopy.	Reading: Chapter on light microscopy techniques.
	Microscopy: Principles of electron microscopy.	Assignment: Prepare a report on the difference between light and electron microscopy.
Week 4	Morphology and arrangement of bacteria.	Reading: Chapter on bacterial morphology.
	Detailed anatomy of bacterial cell.	Assignment: Draw and label a detailed diagram of a bacterial cell.
Week 5	Bacterial taxonomy and nomenclature.	Reading: Chapter on bacterial classification.
	Basis of classification of bacteria.	Assignment: Research and prepare a presentation on a specific group of bacteria.
Week 6	Growth of microorganisms: Factors influencing microbial growth.	Reading: Chapter on microbial growth.

	Nutritional requirements for microorganisms. (Sources of energy, C, N, H, O, S, P, trace elements)	Assignment: Prepare a table showing the nutritional requirements of bacteria.
Week 7	Nutritional types of microorganisms.	Reading: Chapter on nutritional types (autotrophs, heterotrophs).
	Growth factors for microorganisms and their impact on microbial development.	Assignment: Prepare a case study on the role of growth factors in microbial growth.
Week 8	Reproduction in microorganisms.	Reading: Chapter on bacterial reproduction (binary fission, sporulation).
	Methods of studying microorganisms: Cultivation and isolation techniques.	Assignment: Practical demonstration of cultivating bacteria on agar plates.
Week 9	Purification and characterization of microorganisms.	Reading: Chapter on isolation and characterization techniques.
	General methods of studying microorganisms: Staining techniques (Gram stain, acid-fast stain).	Assignment: Perform Gram staining on bacterial samples.
Week 10	Control of microorganisms: Physical methods (heat, filtration, radiation).	Reading: Chapter on physical methods of microbial control.
	Chemical methods of controlling microorganisms: Alcohols, aldehydes, and phenols.	Assignment: Create a comparative chart of chemical disinfectants.
Week 11	Sterilization and disinfection: Types and processes.	Reading: Chapter on sterilization methods.
	Sterilization and disinfection: Physical methods – Dry heat, moist heat, and filtration.	Assignment: Research on specific sterilization techniques and their applications in healthcare.
Week 12	Chemical sterilization methods: Alcohols, aldehydes, halogens, and gases.	Reading: Chapter on chemical sterilization methods.
	Chemical sterilization methods: Dyes, phenols, and other disinfectants.	Assignment: Case study on a hospital's sterilization protocols using chemical agents.
Week 13	Antibiotics: History and discovery.	Reading: Chapter on the history and types of antibiotics.
	Modes of action of antibiotics: Inhibition of cell wall synthesis, protein synthesis, etc.	Assignment: Write an essay on how antibiotics interfere with microbial metabolism.
Week 14	Chemotherapeutic agents and their application in microbial treatment.	Reading: Chapter on chemotherapeutic agents in medicine.
	Antibiotic resistance: Mechanisms and prevention.	Assignment: Prepare a presentation on the development of antibiotic resistance.
Week 15	Fungi: Basic properties, structure, and classification.	Reading: Chapter on fungi in microbiology.
	Fungal diseases and their medical significance.	Assignment: Research on common fungal infections in humans.
Week 16	Overview of microbiological laboratory safety and ethics.	Reading: Chapter on laboratory safety procedures.
	Review and discussion of key concepts from the course.	Assignment: Final review of course content; prepare for final exam.

Course Content (Lab)		Assignments/Readings
Week 1	Laboratory Safety: Containment and decontamination procedures, and safety protocols in microbiology.	Reading: Chapter on laboratory safety and decontamination procedures.
Week 2	Equipment and materials used in microbiology: Glassware, sterilization techniques, and proper handling.	Assignment: Write a report on the types of glassware and equipment used in microbiological experiments.
Week 3	Inoculation techniques: Introduction to aseptic techniques and proper inoculation practices.	Reading: Chapter on inoculation and aseptic techniques.
Week 4	Pour Plate Method: Preparation of agar plates and inoculation using the pour plate method.	Assignment: Perform the pour plate method and explain its applications in microbial isolation.
Week 5	Spread Plate Method: Inoculation of agar surface with diluted microbial sample using spread plate method.	Assignment: Prepare a report on the differences between pour and spread plate methods.
Week 6	Streak Plate Method: Isolation of bacterial colonies using the streak plate method.	Assignment: Demonstrate and describe the streak plate method and its importance in isolating pure cultures.
Week 7	Introduction to Microscopy: Principles and use of light microscope, focusing techniques.	Reading: Chapter on microscopy techniques and focusing methods.
Week 8	Gram Staining Technique: Preparation of bacterial smear and Gram staining procedure.	Assignment: Prepare a Gram-stained slide and interpret the results.
Week 9	Acid-Fast Staining: Preparation and staining of bacteria using the acid-fast staining method.	Assignment: Perform acid-fast staining and compare it to Gram staining.
Week 10	Study of Motility of Bacteria: Use of hanging drop preparation to study bacterial motility.	Assignment: Prepare and observe hanging drop preparations of motile bacteria.
Week 11	Preparation and use of Blood Agar and Chocolate Agar for bacterial culture.	Assignment: Compare the growth of different bacteria on Blood and Chocolate Agar.
Week 12	Use of MacConkey Agar and Mannitol Salt Agar for selective bacterial growth.	Assignment: Prepare and incubate bacterial cultures on MacConkey and Mannitol Salt Agar.
Week 13	Use of TCBS Agar and SDA Agar for isolation of specific pathogens (e.g., Vibrio and fungi).	Assignment: Isolate Vibrio species and fungi on TCBS and SDA Agar respectively.
Week 14	Antibiotic Susceptibility Testing: Disk diffusion method to test bacterial resistance to antibiotics.	Assignment: Perform antibiotic susceptibility testing using the disc diffusion method and analyze the results.
Week 15	Estimation of Minimum Inhibitory Concentration (MIC) by broth dilution method.	Assignment: Perform MIC estimation for selected antibiotics using broth dilution.
Week 16	Estimation of MIC by agar dilution method and Anaerobic culture techniques.	Assignment: Compare MIC results from broth and agar dilution methods, and demonstrate anaerobic culture methods.
Textbooks and Reading Material		

- **Fundamentals of Microbiology** by **Ralph E. Petroff and Mark A. Hibbett**, **Edition:** 12th edition, **Year:** 2023
- **Microbiology: A Systems Approach** by **Marjorie Kelly Cowan** and **Kathleen Park Talaro**, **Edition:** 10th edition, **Year:** 2022
- **Microbiology: An Introduction** by **Gerard J. Tortora**, **Bertino R. Funke**, and **Christine L. Case, Edition:** 13th edition, **Year:** 2022
- **Brock Biology of Microorganisms** by **Michael T. Madigan**, **John M. Martinko**, and **David A. Stahl, Edition:** 17th edition, **Year:** 2020

Teaching Learning Strategies

1. **Interactive Lectures**
   Engage students with interactive presentations, discussions, and real-time corrections of writing and speaking errors.
2. **Collaborative Learning**
   Students will work in pairs or small groups to write essays, analyze readings, and give peer feedback on presentations.
3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Lab Technology	Course Code	MLT-109	Credit Hours	2 (2+0)
Course Title	Pakistan Studies				

Course Introduction

This course is designed to provide students with a comprehensive exploration of Pakistan`s identity, spanning geographical, historical, and cultural dimensions. It delves into the diverse landscapes, ancient civilizations, and rich cultural heritage that define Pakistan. Moreover, it examines the socio-cultural and political transformations in Pakistan over time including democratic transitions and military interventions. The aim of this course is to inculcate in students a nuanced understanding of Pakistan`s, present, and potential future trajectories, enabling them to critically evaluate the complex dynamics shaping the development.

Learning Outcomes

On the completion of the course, the students will:

1. Have enhanced knowledge of the geographical, historical, and political aspects of Pakistan.
2. Understand the society and culture of Pakistan.
3. Understand explain the Socio-economic developments in Pakistan.
4. Explore contemporary issues and challenges faced by Pakistan and their implications for the future..

Course Content

1. **Introduction to Pakistan**
   - Geographical location and significance.
   - Historical background ancient civilizations in the region.
   - Factors leading to the creation of Pakistan
2. **Political History of Pakistan:**
   - Formative phase.
   - Military interventions and democratic transitions.
3. **Geography of Pakistan:**
   - Physiography: Mountains, Plains, Plateaus, deserts, valleys and coastal areas.
   - River systems: Indus River and its tributaries.
   - Climatic regions of Pakistan.
4. **Society and Culture of Pakistan:**
   - Socio-cultural diversity.
   - Languages and literature of Pakistan.
5. **Economic Development of Pakistan:**
   - Agriculture and industrial sectors of Pakistan.
   - Economic challenges of Pakistan.

Teaching Learning Strategies

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3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-201	Credit Hours	3(2+1)

Course Title	Introduction to Pharmacology

Course Introduction

This course provides a comprehensive introduction to the fundamental principles of pharmacology, focusing on the **pharmacokinetics** (how the body processes drugs) and **pharmacodynamics** (how drugs affect the body) of various substances. The course aims to familiarize students with the core concepts of pharmacology, including the different types of diseases, and how the body interacts with and metabolizes drugs. Students will explore the mechanisms of action, therapeutic uses, and potential adverse effects of important drugs, equipping them with a solid understanding of drug therapy. By the end of the course, students will have a foundational knowledge of how drugs work, their role in treatment, and their impact on the body.

Learning Outcomes

On the completion of the course, the students will:

- Understand the Pharmacokinetics and Pharmacodynamics of Drugs: Demonstrate knowledge of how drugs are absorbed, distributed, metabolized, and excreted by the body, and how they produce their effects.
- Explain Drug Mechanisms of Action: Understand and describe how different types of drugs work at the molecular, cellular, and systemic levels to treat diseases.
- Identify Therapeutic Uses and Adverse Effects of Drugs: Recognize the therapeutic indications for various drugs and understand their potential side effects and risks.
- Apply Pharmacological Knowledge to Clinical Practice: Use pharmacological principles to guide the selection, administration, and monitoring of drug therapies in real-world healthcare settings.
- Promote Safe and Rational Drug Use: Understand the importance of safe drug use practices, including recognizing drug interactions and minimizing adverse effects for optimal patient outcomes.

Course Content (Theory)		Assignments/Readings
Week 1	**Introduction to Pharmacology**: Definition and branches of pharmacology. Definition and sources of drugs.	Reading: Chapter on Pharmacology, focusing on definitions and branches of the field.
	Routes of Drug Administration: Advantages and disadvantages of various routes of drug administration.	Assignment: List and compare different routes of drug administration.
Week 2	**Pharmacokinetics I**: Absorption, distribution, metabolism, and elimination of drugs. Factors affecting these processes.	Reading: Chapter on pharmacokinetics.
	Pharmacokinetics II: Pharmacokinetic parameters (Vd, Cl, Biological Half-life, Bioavailability).	Assignment: Solve problems related to pharmacokinetic parameters.
Week 3	**Pharmacodynamics I**: Drug action, receptors, and their molecular structures.	Reading: Chapter on pharmacodynamics.
	Pharmacodynamics II: Agonists, partial agonists, inverse agonists, antagonists (competitive and non-competitive).	Assignment: Prepare a comparison chart for different types of agonists and antagonists.
Week 4	**Pharmacodynamics III**: Median lethal dose (LD50), median effective dose (ED50), and therapeutic index.	Assignment: Discuss the significance of LD50, ED50, and Therapeutic Index in drug safety.
	Dose-Response Relationships: Understanding how dose affects drug response.	Reading: Chapter on dose-response relationships.
Week 5	**Drug Classification I**: Drugs acting on the cardiovascular system (Angina, Coagulants, Anti-coagulants).	Assignment: Create a summary table of drugs used to treat cardiovascular conditions.
	Drug Classification II: Anti-hypertensives, diuretics, and their mechanisms of action.	Reading: Chapter on cardiovascular drugs.

Week 6	**Drugs Acting on Gastrointestinal Tract I**: Treatment of peptic ulcer (Antacids, H2 antagonists, Proton pump inhibitors).	Assignment: Compare the mechanisms of action of different anti-ulcer drugs.
	Drugs Acting on Gastrointestinal Tract II: Emesis and anti-emetics.	Reading: Chapter on gastrointestinal pharmacology.
Week 7	**Anti-inflammatory, Antipyretic, and Analgesic Agents**: Mechanisms and uses.	Assignment: Create a mind map of common anti-inflammatory and analgesic drugs.
	Drugs Acting on CNS & ANS I: Sedatives, hypnotics, and antidepressants.	Reading: Chapter on CNS and ANS drugs.
Week 8	**Drugs Acting on CNS & ANS II**: Antiepileptic drugs, CNS stimulants, and neuromuscular blockers.	Assignment: Identify and categorize different CNS drugs with their uses and side effects.
	Antimicrobials I: Basic principles of chemotherapy, antibacterial agents (sulfonamides, penicillin, etc.).	Reading: Chapter on antimicrobial drugs.
Week 9	**Antimicrobials II**: Protein synthesis inhibitors (Aminoglycosides, Tetracyclines, Macrolides), Nucleic acid synthesis inhibitors (Quinolones).	Assignment: Prepare a comparison table of antibacterial drugs and their mechanisms of action.
	Antimicrobials III: Anti-mycobacterial drugs, antifungal drugs, and antivirals.	Reading: Chapter on antifungal and antiviral drugs.
Week 10	**Drug Calculations I**: Basic arithmetic (addition, subtraction, multiplication, and division).	Assignment: Solve drug calculation problems related to dosages and unit conversions.
	Drug Calculations II: Calculation of dosage by weight, solution strength, and unit conversions.	Reading: Chapter on drug calculations and practical exercises.
Week 11	**Rights of Medication Administration I**: Overview of the rights and their importance in drug administration.	Assignment: Write a short essay on the Rights of Medication Administration.
	Rights of Medication Administration II: Diagnostic imaging agents and their usage.	Reading: Chapter on diagnostic imaging agents and medication rights.
Week 12	**Legal Policies and Responsibilities in Drug Handling I**: Overview of drug laws and regulations.	Assignment: Research local drug handling laws and create a summary.
	Legal Policies and Responsibilities in Drug Handling II: Ethical considerations and handling controlled substances.	Reading: Chapter on drug handling laws and ethics.
Week 13	**Pharmacokinetics Review**: Detailed review and case studies of pharmacokinetics and drug metabolism.	Assignment: Review case studies on pharmacokinetics and answer questions.
	Pharmacodynamics Review: Detailed review and case studies of drug mechanisms and dose-response relationships.	Reading: Chapter on pharmacodynamics case studies.
Week 14	**Cardiovascular System Drugs Review**: Comprehensive review of drugs acting on the cardiovascular system.	Assignment: Prepare a presentation on drugs for cardiovascular diseases, including their mechanisms and side effects.
	Gastrointestinal Drugs Review: Review of drugs acting on the gastrointestinal tract and their therapeutic uses.	Assignment: Prepare a comparison of drugs for peptic ulcers, their actions, and side effects.
Week 15	**CNS & ANS Drugs Review**: Review of drugs acting on the CNS and ANS.	Assignment: Review the side effects and therapeutic uses of CNS and ANS drugs.

	Antimicrobials Review: Comprehensive review of antibiotics, antivirals, and antifungals.	Reading: Chapter on antimicrobial therapy and resistance mechanisms.
Week 16	**Final Review**: Recap of drug calculations, rights of medication administration, and legal responsibilities.	Assignment: Final review quiz covering all aspects of pharmacology, calculations, and legal responsibilities.
	Course Wrap-up and Final Exam Preparation: Summary of key concepts and preparation for the final exam.	Assignment: Study for final exam and review all course content.
Course Content (Lab)		**Assignments/Readings**
Week 1	**Introduction to Pharmacology and Experimental Pharmacology**: Overview of pharmacology and the significance of experimental pharmacology.	Reading: Chapter on Introduction to Experimental Pharmacology.
Week 2	**Handling of Drug Labelling Information**: Learn how to interpret and handle drug labelling information correctly.	Assignment: Prepare a report on the importance of proper drug labelling.
Week 3	**Study of Animals Used for Experimental Pharmacology**: Overview of animals used in pharmacological experiments and ethical considerations.	Reading: Chapter on animals in experimental pharmacology.
Week 4	**Pyrogenic Test of a Given Sample**: Perform a pyrogenic test to check for the presence of pyrogens in a drug sample.	Assignment: Document the procedure and results of the pyrogenic test.
Week 5	**Study of Anticoagulant Effect of Drugs on Clotting Time**: Measure the effect of an anticoagulant on blood clotting time.	Reading: Chapter on anticoagulants and their mechanisms of action.
Week 6	**Preparation of Standard Solutions**: Prepare Ringer's solution/Tyrode solution and discuss their pharmacological relevance.	Assignment: Prepare a report on the composition and uses of Ringer's and Tyrode solutions in experimental pharmacology.
Week 7	**Study of the Effects of Pilocarpine on Rabbit's Eyes**: Observe the effects of Pilocarpine on the pupil size of rabbits.	Reading: Chapter on Pilocarpine and its mechanism of action.
Week 8	**Conversion of Drug into Excretory Form**: Study the conversion of drugs into their excretory forms, including metabolism.	Assignment: Prepare a report on the different phases of drug metabolism and excretion.
Week 9	**Effect of Drug on Blood Pressure**: Study the effect of a drug on rabbit blood pressure using a suitable instrument.	Reading: Chapter on the effects of drugs on cardiovascular parameters.
Week 10	**Effect of Drug on Respiration**: Measure the impact of a drug on the respiratory rate of rabbits.	Assignment: Write a report on the effects of respiratory drugs and their mechanisms.
Week 11	**Study of Drug-Induced Tachycardia**: Observe the effects of drugs on heart rate, specifically focusing on tachycardia.	Reading: Chapter on drugs that influence heart rate and their pharmacological actions.
Week 12	**Toxicity Study of Drug on Liver Function**: Evaluate the effect of a drug on liver enzymes in animal models.	Assignment: Document and analyze the results of a drug toxicity study on liver function.
Week 13	**Measurement of Renal Function After Drug Administration**: Study the impact of drugs on kidney function.	Reading: Chapter on the effects of drugs on renal function.
Week 14	**Effect of Drug on Gastrointestinal Motility**: Investigate the effects of drugs on gastrointestinal motility.	Assignment: Prepare a comparison report on drugs affecting gastrointestinal motility.
Week 15	**Drug-Induced Sedation Study**: Measure the effect of a drug on the sedation level in animals.	Reading: Chapter on sedative drugs and their clinical uses.

Week 16	**Final Practical Report & Review**: Consolidate practical knowledge and present findings from previous experiments.	Assignment: Prepare a final report summarizing all experiments and their pharmacological relevance.

Textbooks and Reading Material

- Bray, G. A., & Bouchard, C. (2019). *Handbook of Obesity, Two-Volume Set.* CRC Press.
- Whalen, K., Feild, C., & Radhakrishnan, R. (2018). *Pharmacology.* LWW.
- Stawicki, S. P., Firstenberg, M. S., Galwankar, S. C., Izurieta, R., & Papadimos, T. (2021). *Contemporary Developments and Perspectives in International Health Security: Volume 1.* BoD – Books on Demand.
- Wang, B. (2022). *Medical Equipment Maintenance: Management and Oversight.* Springer Nature.
- Whalen, K. (2018). *Lippincott® Illustrated Reviews: Pharmacology.* Wolters Kluwer India Pvt.
- Katzung, B. G., & Trevor, A. J. (2020). *Basic and Clinical Pharmacology, 15e.* McGraw-Hill Education / Medical.
- Ritter, J. M., Flower, R. J., Henderson, G., Loke, Y. K., MacEwan, D., Robinson, E., & Fullerton, J. (2023). *Rang & Dale's Pharmacology* (E-book). Elsevier Health Sciences.

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3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-202	Credit Hours	3(2+1)
Course Title	Immunology & Serology				

Course Introduction

This course offers students a comprehensive understanding of basic immunology, with a focus on both cellular and molecular mechanisms that are essential to the immune system. It covers the fundamentals of **innate** and **adaptive immunity**, highlighting the structure and function of key immune receptors, including **immunoglobulins**, **immune cell receptors**, and **innate pattern recognition receptors**. The course will explore the mechanisms behind **antibody production** and the molecular processes involved in **cellular immunity**, particularly the interactions between **T cells**, **B cells**, and the development of **lymphocyte memory**. Students will also gain insight into the connections between immunology and medical science, with an emphasis on its applications in disease prevention, diagnosis, and therapeutic interventions.

Learning Outcomes

On the completion of the course, the students will:

- **Understand the fundamentals of the immune system**, including the distinction between innate and adaptive immunity and the roles of various immune cells and molecules.
- **Identify and describe key immune receptors**, including immunoglobulins, immune cell receptors, and pattern recognition receptors, and explain their functions in immune responses.
- **Explain the process of antibody formation**, including the molecular mechanisms involved and how antibodies contribute to immune defense.
- **Comprehend the mechanisms of cellular immunity**, focusing on the interactions between T cells, B cells, and the formation of lymphocyte memory.
- **Apply knowledge of immunology** to medical science, recognizing its relevance in disease prevention, diagnostic testing, and therapeutic interventions.
- **Analyze and evaluate key concepts in serology**, including the use of immunological techniques for disease detection and diagnosis.
- **Develop critical thinking skills** in interpreting the molecular and cellular processes of immunity and their implications in health and disease.

Course Content (Theory)		Assignments/Readings
Week 1	**Introduction to Immunity**: Definition of immunity, innate immunity, acquired immunity (humoral and cell-mediated immunity).	Reading: Chapter on Immunity basics and innate vs. acquired immunity.
	Active and Passive Immunity: Understanding active vs passive immunity and the role of vaccination.	Assignment: Compare active and passive immunity and provide examples of each.
Week 2	**Antigens and Immunogens**: Types, characteristics, and the role of adjuvants in immune response.	Reading: Chapter on antigens, immunogens, and adjuvants.
	Cellular Basis of Immune Response: T-cells and subtypes, B cells, antigen-presenting cells, activation of T-cells and B-cells.	Assignment: Discuss the roles of T-cells and B-cells in immunity.
Week 3	**Memory Cells**: Formation of memory cells and their role in long-term immunity.	Reading: Chapter on memory cells and their importance in immunity.
	Immunoglobulins: Structure, types, classes, isotypes, allotypes, idiotypes, monoclonal antibodies, and hybridoma technology.	Assignment: Write a report on the structure of immunoglobulins and monoclonal antibodies.
Week 4	**Humoral Immune Response**: Primary and secondary immune response.	Reading: Chapter on humoral immunity and the differences between primary and secondary immune responses.
	Major Histocompatibility Complex (MHC): Types of MHC and their role in transplantation and allograft	Assignment: Discuss the role of MHC in transplantation and graft

	rejection.	rejection.
Week 5	**Complement System**: Pathways of activation, biological effects, and clinical manifestations.	Reading: Chapter on the complement system and its biological functions.
	Antigen-Antibody Reactions: Precipitation, agglutination, radioimmunoassay, ELISA, complement fixation assays, hemagglutination.	Assignment: Perform a case study on antigen-antibody reactions and their applications in diagnostics.
Week 6	**Neutralization Assays**: Techniques used to measure antigen-antibody interactions.	Reading: Chapter on neutralization assays and their use in immunology.
	Coombs Test: Understanding the antiglobulin (Coombs) test for detecting antibodies.	Assignment: Prepare a report on the significance of the Coombs test in diagnosing autoimmune conditions.
Week 7	**ABO and Rh Blood Group System**: Antigens and antibodies related to ABO and Rh systems.	Reading: Chapter on ABO and Rh antigen systems, including blood typing methods.
	Hypersensitivity: Types of hypersensitivity reactions and their immunological basis.	Assignment: Write an essay on the different types of hypersensitivity reactions and examples of each.
Week 8	**Tolerance**: B-cell and T-cell tolerance mechanisms in maintaining immune system balance.	Reading: Chapter on immune tolerance and its importance in preventing autoimmune diseases.
	Autoimmune Disorders: The factors associated with autoimmune disorders and their pathophysiology.	Assignment: Prepare a case study on a specific autoimmune disease and its underlying immunological factors.
Week 9	**Immunodeficiency**: Types of immunodeficiencies, both congenital and acquired.	Reading: Chapter on immunodeficiency disorders and their impact on immune function.
	Congenital Immunodeficiencies: Study of primary immunodeficiencies, genetic factors, and clinical manifestations.	Assignment: Discuss examples of congenital immunodeficiencies and their clinical management.
Week 10	**Acquired Immunodeficiencies**: HIV/AIDS and other acquired immunodeficiencies, their immune mechanisms.	Reading: Chapter on acquired immunodeficiencies and the HIV/AIDS pathogenesis.
	Vaccination and Immunization: The role of vaccines in preventing diseases and their mechanisms of action.	Assignment: Prepare a report on the significance of vaccination in disease prevention.
Week 11	**Immunization Strategies**: Different types of vaccines, including live attenuated, inactivated, subunit, and mRNA vaccines.	Reading: Chapter on different vaccine types and their immunological mechanisms.
	Adjuvants in Vaccination: Mechanisms of adjuvants in enhancing immune responses to vaccines.	Assignment: Research and summarize the role of adjuvants in modern vaccine development.
Week 12	**Clinical Applications of Immunology**: Use of immunological techniques in diagnosing diseases.	Reading: Chapter on the clinical applications of immunology in diagnostics.
	Transplant Immunology: Role of MHC in organ transplantation and the immune response.	Assignment: Prepare a report on transplant immunology and strategies to prevent transplant rejection.
Week 13	**Immunological Methods in Diagnostics**: ELISA, RIA, Western blotting, and flow cytometry.	Reading: Chapter on immunological diagnostic techniques.

	Immunotherapy: Emerging therapies based on immune modulation, including monoclonal antibodies and checkpoint inhibitors.	Assignment: Write an essay on the role of immunotherapy in cancer treatment.
Week 14	**Cancer Immunology**: The immune response to cancer and the role of immunotherapy in cancer treatment.	Reading: Chapter on cancer immunology and the immune system's interaction with tumors.
	Immunological Memory: Understanding the principles behind immunological memory and vaccine development.	Assignment: Discuss how immunological memory is utilized in vaccine development.
Week 15	**Molecular Basis of Immunity**: Genetic regulation of immune responses and immune diversity.	Reading: Chapter on molecular mechanisms governing immunity and immune system regulation.
	Therapeutic Applications of Immunology: Use of immunological knowledge in treating diseases, including vaccines and immunotherapies.	Assignment: Case study on the use of immunological approaches in clinical treatment.
Week 16	**Review of Key Concepts**: Summary of key topics in immunology, including humoral and cellular immunity, and their clinical relevance.	Reading: Review chapters and previous assignments to prepare for final exam.
	Final Examination and Case Study Discussions: Examination of immunology principles, applications, and case study analysis.	Assignment: Prepare for final exam by reviewing all course materials.
Course Content (Lab)		**Assignments/Readings**
Week 1	**Introduction to Serological Diagnosis**: Overview of serological techniques used in microbial disease diagnosis.	Reading: Introduction to serological methods for microbial diagnosis.
Week 2	**Widal Test**: Performing and interpreting the Widal test for typhoid fever diagnosis.	Assignment: Perform Widal test and interpret results for a case study of typhoid fever.
Week 3	**ASO Titer**: Procedure for determining antistreptolysin O (ASO) titer in diagnosing streptococcal infections.	Reading: Chapter on ASO titer and its significance in streptococcal infections.
Week 4	**CRP Titer**: Measuring C-reactive protein levels and its role in detecting inflammation and infection.	Assignment: Calculate and interpret CRP titer results from a clinical sample.
Week 5	**RA Factor Test**: Performing the rheumatoid arthritis (RA) factor test and its clinical significance in diagnosing autoimmune diseases.	Reading: Chapter on RA factor and its role in autoimmune diseases.
Week 6	**VDRL Test**: Procedure for the Venereal Disease Research Laboratory (VDRL) test to diagnose syphilis.	Assignment: Interpret VDRL test results and discuss its use in syphilis diagnosis.
Week 7	**RPR Test**: Performing the Rapid Plasma Reagin (RPR) test for syphilis and understanding its limitations and applications.	Reading: Chapter on RPR test and comparison with VDRL.
Week 8	**ELISA for HBV**: Performing an Enzyme-Linked Immunosorbent Assay (ELISA) for Hepatitis B Virus (HBV) detection.	Assignment: Write a report on how ELISA works for detecting HBV and its clinical significance.
Week 9	**ELISA for HCV**: Procedure for detecting Hepatitis C Virus (HCV) antibodies using ELISA technique.	Reading: Chapter on ELISA technique for HCV detection and its diagnostic value.
Week 10	**Tuberculin Skin Test**: Performing and interpreting the tuberculin skin test (TST) for tuberculosis diagnosis.	Assignment: Discuss the advantages and limitations of the tuberculin skin test in TB diagnosis.
Week 11	**Skin Prick Test for Allergic Diseases**: Performing skin	Reading: Chapter on skin prick test

	prick testing for common allergens.	and its role in diagnosing allergic diseases.
Week 12	**ANA Test**: Performing the Antinuclear Antibody (ANA) test for diagnosing autoimmune diseases such as lupus.	Assignment: Write a case study on interpreting ANA test results for lupus diagnosis.
Week 13	**Anti-dsDNA Test**: Procedure for detecting anti-double stranded DNA (anti-dsDNA) antibodies, often used in lupus diagnosis.	Reading: Chapter on anti-dsDNA test and its use in diagnosing systemic lupus erythematosus (SLE).
Week 14	**Immunological Tests for Immunological Disorders**: Overview of tests for disorders like rheumatoid arthritis, lupus, etc.	Assignment: Compare the clinical significance of ANA and anti-dsDNA in diagnosing autoimmune disorders.
Week 15	**Data Analysis and Interpretation**: Analyzing the results from various serological tests and discussing clinical implications.	Assignment: Prepare a report on interpreting the results from all tests conducted and their diagnostic value.
Week 16	**Review and Practical Exam**: Review of all serological tests covered during the course and practical exam.	Assignment: Final practical exam to assess proficiency in performing serological tests and interpreting results.

Textbooks and Reading Material

- Owen, Judith A., Jenni Punt, and Sharon A. Stranford. ***Kuby immunology***. New York: WH Freeman, 2013.
- Review of Medical Microbiology and Immunology, 12th Edition, Mc Graw Hill Medical, New York

Teaching Learning Strategies

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Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.

2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-203	Credit Hours	3(2+1)
Course Title	Cell Biology & Histopathology				

Course Introduction

The course on **Cell Biology & Histopathology** aims to provide students with a comprehensive understanding of the structure, function, and organization of cells and tissues at the microscopic level. The course will cover the basic principles of cell biology, including the study of cellular components such as the nucleus, mitochondria, and cytoskeleton, and their roles in maintaining cellular functions. Students will explore cell division, signal transduction, and molecular mechanisms that regulate cellular processes. The histopathology section of the course will introduce students to the study of tissue structure, function, and disease at the microscopic level, focusing on how alterations in normal tissue can lead to disease processes. The course will also address various staining techniques, tissue processing, and microscopy methods used in histopathology to identify pathological changes in tissues. This course will integrate both theoretical knowledge and practical techniques, providing students with foundational skills essential for understanding cellular and tissue abnormalities in health and disease.

Learning Outcomes

On the completion of the course, the students will:

- Describe the structure and function of cellular organelles and explain their roles in cellular processes.
- Understand the stages of the cell cycle and the regulation of cell division, apoptosis, and senescence.
- Explain cellular signaling and signal transduction mechanisms and their role in development and disease.
- Identify and describe the structure and function of different tissue types and their physiological roles.
- Apply histopathological techniques to prepare, stain, and interpret tissue samples.
- Recognize and describe pathological changes in tissues and correlate them with clinical conditions.
- Integrate knowledge of cell biology and histopathology to analyze disease processes and support diagnostics.
- Present histopathological findings clearly and effectively in written and oral formats.

Course Content (Theory)		Assignments/Readings
Week 1	**Introduction to Basic Histology**: Structure and chemical constituents of cells and cellular organelles.	Read Chapter 1: Cell Biology and Histology Fundamentals.
	Classification of Tissue: Epithelium, Connective tissue, Muscular tissue, Nervous tissue.	Read Chapter 2: Tissue Classification and Histology.
Week 2	**Introduction to Surgical Specimens and Biopsy**: Types of biopsies, merits and demerits.	Review case studies on biopsy methods.
	Fixation Methods: Salient gross and microscopic changes in diseases of the gastrointestinal tract.	Read Chapter 3: Fixation Techniques and Their Importance.
Week 3	**Fixation Methods**: Genitourinary System diseases (Male and Female).	Review literature on fixation and its application in GI pathology.
	Fixation Methods: Respiratory tract diseases, Brain and spinal cord.	Case study on respiratory tract biopsy findings.
Week 4	**Fixation Methods**: Skin, subcutaneous tissues, Heart, and blood vessels.	Read articles on histopathological changes in cardiac tissues.
	Fixation Methods: Lymphatic system, including tonsils, lymph nodes, spleen, thymus.	Review case studies on lymphatic system diseases.
Week 5	**Histological Techniques**: Basic requirements and general organization of a histopathological lab.	Research paper on lab organization for histology work.
	Supravital Staining: Principles and techniques.	Review of supravital staining in diagnostic applications.
Week 6	**Tissue Processing - Part 1**: Fixation, dehydration, and clearing (aim and agents used).	Practical exercises on dehydration and clearing agents.
	Tissue Processing - Part 2: Impregnation, embedding, and	Lab session: Embedding tissues and

	casting.	preparing for sectioning.
Week 7	**Microtomy**: Techniques for blocking, section cutting with a rotary microtome.	Watch video on microtome operation and section cutting.
	Microtome Knives: Types, principles, and operation.	Read chapter on microtome use and maintenance.
Week 8	**Frozen Sections**: Principles, methods, staining, and applications.	Lab session on preparing frozen sections.
	Frozen Sections: Advantages, disadvantages, and common techniques.	Review articles on the advantages of frozen section analysis.
Week 9	**Decalcification**: Techniques, aim, and agents used for decalcification.	Study the importance of decalcification in bone and tissue analysis.
	Museum Techniques: Organization and mounting of specimens in preservative fluids.	Review on museum specimen preparation.
Week 10	**Staining Techniques - Part 1**: Principles and classification of acid and basic dyes.	Study routine Hematoxylin-Eosin staining method.
	Special Staining Techniques: GMS, Mucicarmine, Alcian Blue, Masson's Trichrome.	Practice special staining techniques on tissue slides.
Week 11	**Special Staining Techniques**: Mallory's connective tissue stain, Toluidine blue, Von-Geison.	Read and practice using Mallory's stain for connective tissues.
	Staining for Frozen Sections: PAS Technique and its application.	Review PAS staining method with case study examples.
Week 12	**Immunohistochemistry (IHC) - Introduction**: Basic principles, significance, and methods.	Review literature on direct and indirect IHC methods.
	Immunohistochemistry (IHC) - Techniques: PAP/Avidin Biotin method, steps involved, antigen retrieval.	Hands-on IHC staining and antigen retrieval techniques.
Week 13	**Immunohistochemistry (IHC) - Part 2**: Types of fixatives, buffering media, enzyme labels, and chromogens used.	Practical application: Different enzyme labels in IHC.
	Immunohistochemistry (IHC) - Part 3: Commonly used tumor markers and their clinical utility.	Review case studies with tumor markers in different diseases.
Week 14	**Histopathological Analysis of GI Tract**: Common diseases and histological findings.	Lab session: Staining of GI tract tissue samples.
	Histopathological Analysis of Respiratory Tract: Diseases and histological analysis.	Practical session: Respiratory tract tissue slides.
Week 15	**Histopathological Analysis of Nervous System**: Brain and spinal cord diseases.	Case study on nervous system pathologies.
	Histopathological Analysis of Cardiovascular System: Heart and blood vessels.	Lab work on heart tissue specimens.
Week 16	**Histopathological Analysis of Lymphatic System**: Tonsils, lymph nodes, spleen, and thymus.	Practical session on lymphatic tissue staining and analysis.
	Review and Discussion: Recap of all histological techniques and applications in various systems.	Final review and practical examination.
Course Content (Lab)		**Assignments/Readings**
Week 1	**Introduction to Tissue Processing**: Overview of the basic steps of tissue processing (fixation, dehydration, clearing).	Read Chapter 1: Introduction to Tissue Processing. Watch a video on basic tissue processing.
Week 2	**Preparation of Fixatives**: Types of fixatives and their preparation methods.	Read Chapter 2: Fixatives and their role in histology. Prepare different fixatives in the lab.
Week 3	**Fixation Techniques**: Overview of various fixation techniques, including chemical and physical methods.	Practice fixation of tissue samples using different methods.

Week 4	**Embedding Techniques**: Paraffin embedding – Principles and practical steps.	Hands-on paraffin embedding of tissue samples.
Week 5	**Embedding Techniques**: Celloidin embedding – Comparison with paraffin embedding.	Compare and contrast paraffin and celloidin embedding methods. Practice celloidin embedding.
Week 6	**Microtomy**: Section cutting using a rotary microtome (Paraffin sections).	Section paraffin-embedded tissue using a rotary microtome.
Week 7	**Microtomy**: Sectioning of celloidin-embedded tissue using the microtome.	Hands-on sectioning of celloidin-embedded tissue with microtome.
Week 8	**Frozen Sectioning**: Principles and techniques of frozen sectioning using a cryostat.	Demonstration and practice of frozen sectioning.
Week 9	**Staining: Hematoxylin and Eosin (H&E)**: Principles and procedure of H&E staining.	Practice H&E staining on paraffin sections.
Week 10	**Special Staining Techniques**: Introduction to special stains (e.g., GMS, Masson's Trichrome).	Prepare slides using special stains for various tissue types.
Week 11	**Mounting Techniques**: Principles and methods of mounting stained tissue sections.	Practice mounting stained sections using various mounting media.
Week 12	**Grossing of Tissue**: Techniques for preparing tissue samples for histological analysis.	Practice grossing of different tissue samples for histology preparation.
Week 13	**Decalcification**: Techniques and reagents used for decalcification of bone tissue.	Demonstration and hands-on practice using decalcifying agents on bone tissue.
Week 14	**Automated Tissue Processing**: Demonstration and principles of automated tissue processing machines.	Observe and understand the working of an automated tissue processor.
Week 15	**Paraffin Sectioning and Staining**: Advanced practice in sectioning paraffin-embedded tissues and H&E staining.	Complete practical session: Paraffin sectioning, H&E staining, and mounting.
Week 16	**Final Practical Exam & Review**: Review of all tissue processing techniques and application.	Final practical exam covering tissue processing, sectioning, staining, and mounting techniques.

Textbooks and Reading Material

- Histology and Histopathology Textbook by James S. Stenzel
- Basic Histology: Text & Atlas by Luiz Carlos Junqueira and José Carneiro
- Clinical and Diagnostic Applications of Immunohistochemistry by P. O'Malley

Teaching Learning Strategies

1. **Interactive Lectures**
   Engage students with interactive presentations, discussions, and real-time corrections of writing and speaking errors.
2. **Collaborative Learning**
   Students will work in pairs or small groups to write essays, analyze readings, and give peer feedback on presentations.
3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-204	Credit Hours	3 (2+1)
Course Title	Hematology				

Course Introduction

This course provides a foundational understanding of hematology, focusing on the basics of blood cells, their formation, and the coagulation (hemostasis) system. Students will learn about the different types of blood cells, how they are produced in the bone marrow, and their functions in the body. The course will also cover the structure and function of hemoglobin, as well as the basics of blood clotting and coagulation disorders. With a combination of theory and practical exercises, students will gain essential knowledge of hematology that is fundamental for clinical practice and diagnostics.

Learning Outcomes

On the completion of the course, the students will:

- **Understand Blood Cell Formation**: Describe the process of hematopoiesis, including the formation of different blood cells in the bone marrow.
- **Identify Blood Cell Types**: Recognize and differentiate the various types of blood cells (e.g., red blood cells, white blood cells, platelets) based on their structure, function, and morphology.
- **Explain Hemoglobin Structure and Function**: Understand the structure and synthesis of hemoglobin, and its role in oxygen transport.
- **Understand Hemostasis Mechanisms**: Explain the basic mechanisms of blood clotting, including the roles of platelets, clotting factors, and the coagulation cascade.
- **Identify Coagulation Disorders**: Recognize common coagulation disorders (e.g., hemophilia, thrombophilia) and their impact on the hemostasis system.
- **Perform Basic Hematology Laboratory Techniques**: Demonstrate practical skills in performing basic hematological tests, such as blood smears, hemoglobin estimation, and coagulation assays.
- **Apply Hematology Knowledge in Clinical Settings**: Relate hematology principles to clinical scenarios, understanding how blood disorders affect health and how to interpret hematological test results.

Course Content (Theory)		Assignments/Readings
Week 1	**Introduction to Hematology**: Meaning and concept of hematology.	Introduction to Hematology.
	Need and Importance of Hematology: Role of hematology in clinical diagnostics and treatment.	Review articles on the importance of hematology in health.
Week 2	**Review of Vascular System and Blood Constituents**: Overview of blood composition and vascular system.	Study the structure of blood vessels and components in blood.
	Anatomy of Bone Marrow and Hematopoiesis: Structure of bone marrow and the process of blood cell formation.	Hematopoiesis and Bone Marrow Anatomy.
Week 3	**Blood Formation (Intra-uterine and Extra-uterine)**: How blood is formed during pregnancy and after birth.	Review articles on fetal hematopoiesis.
	Factors Governing Hematopoiesis: Hormonal and cytokine regulation of blood cell production.	Study the influence of cytokines and hormones in hematopoiesis.
Week 4	**Stages of Normal Cell Maturation**: Erythropoiesis, leukopoiesis, and thrombopoiesis.	Review the stages of blood cell maturation.
	Blood Cell Physiology: Functions and life cycle of red blood cells, white blood cells, and platelets.	Study blood cell function and lifespan.
Week 5	**Phlebotomy & Anticoagulants**: Types and methods of blood collection, including physical and chemical anticoagulants.	Review techniques and anticoagulants used in blood collection.
	Chemical Anticoagulants: Mechanisms of action, preparation, and use of important chemical anticoagulants.	Read on common anticoagulants used in clinical practice.
Week 6	**Physical Anticoagulants**: Physical methods to prevent	Watch videos on physical

	clotting, such as cooling or heparin.	anticoagulation techniques.
	Mode of Action and Use of Anticoagulants: How anticoagulants function in clinical applications.	Study clinical case scenarios involving anticoagulant therapy.
Week 7	**Bone Marrow Examination and Aspiration**: Equipment and techniques for bone marrow aspiration.	Review bone marrow aspiration and preparation of smears.
	Processing and Staining of Bone Marrow Smears: Techniques for staining and interpreting bone marrow samples.	Perform staining techniques on bone marrow smears in the lab.
Week 8	**Bone Marrow Trephine Biopsy**: Techniques and indications for trephine biopsy.	Review the procedure and purpose of bone marrow trephine biopsy.
	Preservation of Biopsy: Methods for preserving bone marrow biopsy samples.	Study different preservation techniques for bone marrow specimens.
Week 9	**Hemoglobin Structure**: Molecular structure of hemoglobin and its function in oxygen transport.	Hemoglobin Structure and Function.
	Types of Hemoglobin: Different types of hemoglobin and their clinical significance.	Study the types and clinical importance of hemoglobin variants.
Week 10	**Anemia Classification**: Classification of anemia based on morphology and etiology.	Classification of Anemia.
	Morphological Classification of Anemia: Microcytic, macrocytic, and normocytic anemia.	Review diagrams and images of blood smears for different types of anemia.
Week 11	**Etiological Classification of Anemia**: Causes of anemia (nutritional, genetic, acquired).	Study causes and pathophysiology of anemia from textbooks and research.
	Iron Deficiency Anemia: Pathophysiology, diagnosis, and treatment.	Study case studies and treatment approaches for iron deficiency anemia.
Week 12	**Sideroblastic Anemia**: Mechanisms, diagnosis, and management.	Review diagnostic techniques for sideroblastic anemia.
	Thalassemia: Genetic basis, classification, and treatment of thalassemia.	Study the genetics and clinical presentation of thalassemia.
Week 13	**Megaloblastic Anemia**: Causes (e.g., vitamin B12 and folate deficiency), diagnosis, and management.	Review clinical case studies on megaloblastic anemia.
	Non-Megaloblastic Macrocytic Anemia: Causes and clinical presentation.	Study the differences between megaloblastic and non-megaloblastic macrocytic anemia.
Week 14	**Anemia of Chronic Disease**: Pathophysiology, diagnosis, and treatment.	Review clinical cases involving anemia of chronic disease.
	Hemolytic Anemia: Classification, causes, and management.	Study clinical presentations and treatment options for hemolytic anemia.
Week 15	**Hereditary Hemolytic Anemia**: Genetic causes and management strategies.	Review research on hereditary hemolytic anemia and treatment approaches.
	Acquired Hemolytic Anemia: Causes, clinical features, and management.	Study clinical cases of acquired hemolytic anemia and laboratory diagnosis.
Week 16	**Aplastic Anemia**: Causes, diagnosis, and treatment of aplastic anemia.	Study clinical management and diagnostic approaches for aplastic anemia.
	Hemostasis & Investigation of Abnormal Hemoglobins:	Perform Hb electrophoresis and

	Techniques like Hb electrophoresis, tests for Hb S, Hb F, and demonstration of Heinz bodies.	review tests for abnormal hemoglobins.
Course Content (Lab)		**Assignments/Readings**
Week 1	**Preparation of Blood Smears**: Preparation of blood smears from collected blood samples.	Read Chapter on Blood Smear Preparation and Microscopy Techniques.
Week 2	**Application of Romanowsky Stains**: Use of Wright-Giemsa stains for microscopic examination.	Study techniques for applying Romanowsky stains in hematology.
Week 3	**Identification of Blood Cell Types**: Identification and analysis of different blood cell types and structures (RBC, WBC, Platelets).	Review images of blood cell types for practical identification.
Week 4	**Examination of Bone Marrow Smears**: Identification of various stages of cell maturation in bone marrow.	Read on the stages of blood cell maturation in bone marrow.
Week 5	**Differentiation of Blood Cells**: Identifying erythroblasts, myeloblasts, and megakaryocytes in bone marrow smears.	Review bone marrow cell differentiation and morphology.
Week 6	**Recording and Analyzing Cell Morphology**: Practice recording and analyzing observed cell morphology in blood and bone marrow smears.	Prepare a report on observed morphology and cell differentiation.
Week 7	**Venipuncture Techniques**: Hands-on practice of venipuncture using simulation models for blood sample collection.	Review the correct technique and safety protocols for venipuncture.
Week 8	**Collection of Blood Samples**: Collection of blood with different types of anticoagulants (EDTA, Heparin, Citrate).	Study the function of different anticoagulants in blood collection.
Week 9	**Blood Smear Preparation for Analysis**: Preparation of blood smears from collected blood samples for microscopic analysis.	Review smear preparation methods and slide mounting techniques.
Week 10	**Bone Marrow Aspiration Simulation**: Simulate the procedure for bone marrow aspiration on models.	Read on the steps involved in bone marrow aspiration and clinical significance.
Week 11	**Bone Marrow Smear Preparation and Staining**: Hands-on practice in preparing and staining bone marrow smears.	Review staining techniques for bone marrow smears.
Week 12	**Handling Bone Marrow Trephine Needles**: Understanding biopsy preservation and handling bone marrow trephine needles.	Study the procedures for bone marrow trephine biopsy and preservation.
Week 13	**Analysis of Hemoglobin Structure**: Analysis of hemoglobin structure using molecular models.	Read on hemoglobin structure and molecular modeling techniques.
Week 14	**Hemoglobin Electrophoresis**: Hands-on demonstration of hemoglobin electrophoresis for hemoglobin analysis.	Study electrophoresis principles and its use in hemoglobinopathies.
Week 15	**Identification of Anemia Types**: Identification and analysis of different types of anemia based on microscopic examination.	Review the microscopic features of different types of anemia.
Week 16	**Basic Hemostasis Tests**: Perform basic hemostasis tests including bleeding time, clotting time, and platelet function.	Study the principles of hemostasis and coagulation pathways.
Textbooks and Reading Material		
• **Hematology: Basic Principles and Practice** by Ronald Hoffman et al. • **Introduction to Hematology** by David A. Steensma • **Practical Hematology** by John P. Greer et al.		
Teaching Learning Strategies		
1. **Interactive Lectures** Engage students with interactive presentations, discussions, and real-time corrections of writing and		

speaking errors.

2. **Collaborative Learning**
   Students will work in pairs or small groups to write essays, analyze readings, and give peer feedback on presentations.
3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-205	Credit Hours	3 (2+1)
Course Title	Forensic Science				

Course Introduction

This introductory course in forensic science is designed specifically for undergraduate students in Allied Health Sciences. It introduces the basic concepts, techniques, and applications of forensic science in healthcare and criminal justice. The course emphasizes the intersection of medical knowledge and forensic investigations, preparing students for roles where both healthcare and forensic science intersect. Students will explore key topics such as forensic pathology, toxicology, DNA analysis, and evidence handling—skills critical in health-related forensic cases, including autopsies, death investigations, and the role of healthcare professionals in criminal investigations.

Through a multidisciplinary approach, this course aims to provide students with an understanding of how healthcare professionals collaborate with forensic scientists, law enforcement, and the legal system to ensure justice and public safety. Topics such as ethical considerations, medico-legal responsibilities, and evidence interpretation will be explored in the context of real-world applications in the healthcare field.

Learning Outcomes

On the completion of the course, the students will:

- **Understand the Role of Forensic Science in Healthcare:** Introduce students to the essential role that forensic science plays in healthcare settings, particularly in relation to death investigations, toxicology, and evidence collection.
- **Develop Basic Forensic Knowledge and Skills:** Equip students with foundational knowledge of forensic methods and techniques commonly used in medical and legal contexts.
- **Explore Key Forensic Specialties:** Focus on areas most relevant to Allied Health students, such as forensic pathology, forensic toxicology, and medico-legal death investigation.
- **Learn Legal and Ethical Implications:** Study the legal and ethical considerations healthcare professionals face when interacting with forensic investigations.
- **Enhance Interdisciplinary Collaboration:** Foster an understanding of how healthcare professionals work alongside forensic scientists, law enforcement officers, and legal experts to ensure the integrity of investigations.

Course Content (Theory)		Assignments/Readings
Week 1	Introduction to Forensic Science	Read an article on the basics of forensic science; Prepare a brief on the role of forensic science in criminal investigations.
	The History of Forensic Science	Research a key historical case in forensic science and prepare a presentation.
Week 2	Ethics and Responsibilities	Case study analysis on ethical dilemmas in forensic investigations.
	Forensic Process	Write a summary of the forensic investigation process, from crime scene to court.
Week 3	Crime Scene Processing	Field exercise: Visit a mock crime scene or analyze a case study. Write a report on the processing steps.
	Crime Scene Processing (Continued)	Role-play crime scene processing with peers; submit a report on the steps taken.
Week 4	Common Types of Physical Evidence	Create a list of common physical evidence types with examples and their relevance.

	Common Types of Physical Evidence (Continued)	Group discussion on types of physical evidence with examples from real cases.
Week 5	Evidence Collection and Preservation	Complete an evidence collection and preservation practice exercise; discuss best practices.
	Evidence Collection and Preservation (Continued)	Hands-on activity: Properly collect and document different types of evidence from a mock scene.
Week 6	Forensic Pathology	Research a real case where forensic pathology played a key role in determining cause of death. Write a report.
	Forensic Pathology (Continued)	Case study on cause of death determination; prepare a report on the forensic autopsy process.
Week 7	Forensic Pathology (Continued)	Research a forensic pathology case involving an unusual cause of death. Prepare a written report.
	Forensic Odontology	Research a famous case where dental evidence was crucial. Prepare a case study report.
Week 8	Forensic Odontology (Continued)	Practical exercise on dental identification techniques; write a summary report.
	Chemistry and Toxicology	Research and summarize the role of toxicology in forensic investigations.
Week 9	Forensic Chemistry and Toxicology (Continued)	Lab exercise: Analyze a sample for toxic substances; submit a lab report.
	Fingerprints Analysis	Practice analyzing fingerprint samples and submit a comparison analysis.
Week 10	Fingerprints Analysis (Continued)	Hands-on exercise: Compare and contrast fingerprint samples; write a comparison report.
	Firearms and Tools Marks	Research a case involving firearm or tool mark identification. Write a case analysis.
Week 11	Firearms and Tools Marks (Continued)	Practical lab session on tool mark analysis; submit a report on the findings.
	Forensic DNA and Serology	Study a high-profile DNA case; write a reflection on its impact on forensic science.
Week 12	Forensic DNA and Serology (Continued)	Study and discuss recent advancements in forensic DNA analysis; submit a discussion summary.
	Forensic DNA and Serology (Continued)	Review and analyze a case involving DNA evidence; write a case analysis.

Week 13	Blood Pattern Analysis	Conduct an analysis of a blood spatter pattern and submit findings in a report.
	Blood Pattern Analysis (Continued)	Practical session: Analyze blood spatter patterns using a case study. Submit a written report on findings.
Week 14	Question Documents	Analyze a questioned document and write a report on its authenticity.
	Question Documents (Continued)	Practice document authentication techniques using real-life examples. Submit a report on findings.
Week 15	Polygraph Analysis	Research the use of polygraphs in criminal investigations; write a reflection on their reliability.
	Polygraph Analysis (Continued)	Debate on the accuracy and legal admissibility of polygraph results. Submit a position paper.
Week 16	Review and Case Study Discussion	Group case study discussion; prepare a presentation analyzing a forensic case of your choice.
	Final Exam Preparation	Study all course materials; prepare a review document summarizing key forensic science concepts.
Course Content (Lab)		**Assignments/Readings**
Week 1	Introduction to Forensic Science	Overview of forensic science tools and techniques; Introduction to forensic laboratories.
Week 2	Crime Scene Processing	Practical demonstration of crime scene investigation (mock crime scene setup).
Week 3	Evidence Collection and Preservation	Hands-on practice in collecting and preserving different types of evidence (biological, physical, trace).
Week 4	Forensic Pathology	Autopsy observation or mock forensic autopsy; understanding post-mortem changes.
Week 5	Forensic Odontology	Practical exercise on dental record comparison and bite mark analysis.
Week 6	Chemistry and Toxicology	Laboratory practice in toxicology: identification of substances (e.g., alcohol, drugs) from samples.
Week 7	Fingerprints Analysis	Fingerprint collection and comparison using ink and powder method or digital methods.
Week 8	Firearms and Tools Marks	Practical exercise in tool mark identification and firearm analysis.
Week 9	Forensic DNA and Serology	DNA extraction from biological samples (e.g., blood, saliva); PCR practice.
Week 10	Blood Pattern Analysis	Practical on blood spatter analysis and interpretation. Create patterns

		and identify type of spatter.
Week 11	Question Documents	Hands-on practice in analyzing and comparing questioned documents (e.g., handwriting, ink analysis).
Week 12	Polygraph Analysis	Introduction to polygraph equipment; demonstration and practice on test setups and interpretations.
Week 13	Firearms and Tools Marks (Advanced)	Advanced session on firearms ballistics and tool mark impressions, including real-life case studies.
Week 14	Forensic Chemistry and Toxicology (Advanced)	Identification and analysis of controlled substances in a lab setup.
Week 15	Forensic Pathology (Advanced)	Practical examination of post-mortem changes using cadavers or mock autopsy models.
Week 16	Review and Case Study Discussion	Practical session reviewing all evidence types and their analysis; students work on case study presentation.

Textbooks and Reading Material

- Forensic Science: An Introduction to Scientific and Investigative Techniques (5th Ed.) – Stuart H. James et al. (CRC Press, 2024)
- Essentials of Forensic Medicine and Toxicology (17th Ed.) – K.S. Narayan Reddy (Medical Publishers Pvt Ltd, 2024)
- Forensic Pathology: Principles and Practice (3rd Ed.) – David S.B.H. Puttick et al. (Academic Press, 2024)
- Forensic Toxicology: Principles and Applications – Richard W. Johnson et al. (Wiley-Blackwell, 2024)

Teaching Learning Strategies

1. **Interactive Lectures**
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2. **Collaborative Learning**
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3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details

1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-206	Credit Hours	3 (2+1)
Course Title	Molecular Biology				

Course Introduction

Molecular Biology and Genetics aim to understand how the molecules that form cells influence the behavior of living organisms. By using molecular and genetic tools, biologists investigate the function of these molecules within the complex environment of the living cell, focusing on both normal and pathological physiology. This knowledge equips students to apply fundamental concepts of molecular biology and genetics to clinical diagnostics, particularly in relation to genetic disorders.

Learning Outcomes

On the completion of the course, the students will:

- Understand the central dogma of molecular biology and its processes.
- Describe the structure and function of DNA, RNA, and proteins.
- Explain DNA replication, transcription, and translation.
- Understand RNA processing and the genetic code.
- Identify gene regulation mechanisms in prokaryotes and eukaryotes.
- Comprehend DNA repair mechanisms and the role of mutations.
- Understand transposable elements and their role in genetic diversity.
- Apply genetic engineering techniques like cloning and recombinant DNA technology.
- Recognize ethical issues in genetic manipulation.
- Develop practical skills in molecular biology techniques such as PCR and gel electrophoresis.

Course Content (Theory)		Assignments/Readings
Week 1	Introduction to Molecular Biology: Overview and significance of the field.	Introduction to Molecular Biology.
	Advances in Molecular Biology: Recent developments and technologies.	Research recent advancements in molecular biology.
Week 2	The Central Dogma of Molecular Biology: Definition and implications.	Study the central dogma and summarize its steps.
	Important Definitions in Molecular Biology: Gene, genome, transcriptome, etc.	Complete definitions exercise.
Week 3	Chemical Structures of Macromolecules: Proteins, nucleic acids, lipids, and carbohydrates.	Review macromolecules and their chemical structures.
	DNA Structure and Function: In-depth discussion of DNA structure.	Draw and label the structure of DNA.
Week 4	DNA Replication: Mechanism of DNA replication in prokaryotes and eukaryotes.	Complete DNA replication mechanism exercise.
	DNA Replication (Continued): Enzymes involved in DNA replication.	Diagram the enzymes involved in DNA replication.
Week 5	Transcription: Process of RNA synthesis from DNA.	Review the process of transcription and summarize steps.
	RNA Processing: Splicing, capping, and polyadenylation in eukaryotes.	Complete RNA processing exercises.
Week 6	Genetic Code: Codons, anticodons, and their role in protein synthesis.	Study genetic code and complete codon chart exercise.
	Translation: Mechanism of protein synthesis.	Prepare a summary of the translation process.
Week 7	Post-translational Modifications: Types and importance in protein function.	List and explain common post-translational modifications.
	Gene Regulation in Prokaryotes: Operon model (lac operon).	Complete a worksheet on operon models.

Week 8	Gene Regulation in Eukaryotes: Transcription factors, enhancers, and silencers.	Research and present on eukaryotic gene regulation.
	Gene Expression Control: Epigenetics, DNA methylation, and histone modifications.	Prepare an overview on epigenetic regulation.
Week 9	Phages: Role of bacteriophages in molecular biology.	Write a report on the significance of phages in genetic research.
	Transposable Elements: Mechanisms of transposition.	Study the types of transposable elements and summarize.
Week 10	Transposable Elements (Continued): Applications and significance in genetic diversity.	Review current research on transposable elements.
	DNA Damage: Types of DNA damage and their causes.	Read on types of DNA damage and summarize key points.
Week 11	DNA Repair Mechanisms: Nucleotide and base excision repair.	Complete exercises on DNA repair mechanisms.
	Mismatch Repair: Mechanism and significance in preventing mutations.	Write a report on the importance of mismatch repair.
Week 12	Double Strand Break Repair: Homologous recombination and non-homologous end joining.	Diagram the repair mechanisms of double-strand breaks.
	Translesion DNA Synthesis: DNA polymerases and their role in damage tolerance.	Review translesion synthesis and summarize key points.
Week 13	Mutation Types: Point mutations, insertions, deletions, and their consequences.	Research mutation types and prepare a report.
	Mutagenesis: Mechanisms of inducing mutations and their use in research.	Complete a worksheet on mutagenesis techniques.
Week 14	Genetic Engineering: Introduction and techniques in genetic modification.	Research and write a report on genetic engineering technologies.
	Recombinant DNA Technology: Cloning, vectors, and plasmids.	Diagram the process of recombinant DNA technology.
Week 15	Applications of Genetic Engineering: Medical and agricultural biotechnology.	Present a case study on the application of genetic engineering.
	Ethical Considerations in Genetic Engineering: Debates and regulations.	Write an essay on the ethical implications of genetic engineering.
Week 16	Review of Key Concepts: DNA replication, transcription, translation, gene regulation.	Review all major topics for the final exam.
	Final Exam Review and Discussions: Recap of the course material and Q&A session.	Final Exam Review Sheet and practice questions.
Course Content (Lab)		**Assignments/Readings**
Week 1	Introduction to Molecular Biology and Molecular Diagnostics	Read Chapter 1: Introduction to Molecular Biology
Week 2	Detection and Quantitative Determination of Chromosomal DNA and RNA	Read Chapter 2: Techniques in Molecular Diagnostics
Week 3	Introduction to Cloning: Overview of cloning experiments	Read Chapter 3: Cloning Techniques and Applications
Week 4	Simple Cloning Experiments Using **Escherichia coli** as a Host	Prepare a report on cloning experiments with E. coli
Week 5	Isolation and Qualitative Detection of Plasmid DNA (Mini Prep)	Read Chapter 4: Plasmid Isolation and Detection
Week 6	Quantitative Detection of Plasmid DNA	Write a summary on the mini prep technique
Week 7	Introduction to Restriction Enzymes	Read Chapter 5: Restriction Enzymes and their Role in Molecular Biology

Week 8	Digestion of DNA with Restriction Enzymes	Perform a lab exercise on restriction enzyme digestion
Week 9	Separation of DNA Fragments on Agarose Gel	Analyze results from agarose gel electrophoresis
Week 10	Study of Transformed Bacteria on the Basis of Antibiotic Resistance	Prepare a report on antibiotic resistance and its application in cloning
Week 11	Techniques in Molecular Diagnostics: PCR and RT-PCR	Read Chapter 6: PCR Techniques and their Role in Molecular Diagnostics
Week 12	Introduction to DNA Sequencing	Prepare a presentation on DNA sequencing methods
Week 13	Genetic Engineering and Applications in Molecular Biology	Read Chapter 7: Genetic Engineering and its Clinical Applications
Week 14	Ethical Implications of Molecular Diagnostics and Genetic Engineering	Write an essay on the ethical considerations in molecular diagnostics and genetic engineering
Week 15	Clinical Applications of Molecular Biology: Genetic Disorders and Pathology	Prepare a case study on genetic disorders and molecular diagnostics
Week 16	Final Review and Practical Applications in Clinical Diagnostics	Review all course materials and prepare for the final exam

Textbooks and Reading Material

- Molecular Biology of the Cell by Alberts et al.
- Molecular Biology by David P. Clark
- Molecular Genetics of Bacteria by Larry Snyder and Wendy Champness

Teaching Learning Strategies

1. **Interactive Lectures**
   Engage students with interactive presentations, discussions, and real-time corrections of writing and speaking errors.
2. **Collaborative Learning**
   Students will work in pairs or small groups to write essays, analyze readings, and give peer feedback on presentations.
3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.

2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-207	Credit Hours	3 (3+0)
Course Title	Human Genetics				

Course Introduction

This course provides a comprehensive overview of the principles of human genetics, focusing on inheritance, genetic variation, and gene expression. Designed for Allied Health Sciences students, it explores Mendelian inheritance, chromosomal structure, genetic mutations, and genetic disorders. Students will gain knowledge on the role of genetics in health, disease, and personalized medicine. Through lectures, laboratory work, and case studies, the course highlights the application of genetic principles in clinical settings, including genetic testing and counseling. Ethical considerations in genetics and its impact on healthcare practices will also be emphasized.

Learning Outcomes

On the completion of the course, the students will:

- **Understand the fundamentals of human genetics**: Explain the principles of inheritance, including Mendelian patterns, and the molecular mechanisms of gene expression.
- **Analyze genetic variation**: Identify how genetic variation occurs within populations and its role in human traits, health, and disease.
- **Interpret genetic disorders**: Understand the causes, inheritance patterns, and clinical implications of common genetic disorders.
- **Apply genetic knowledge in healthcare**: Demonstrate the ability to use genetic testing, counseling, and family history in clinical settings.
- **Evaluate ethical issues in genetics**: Critically assess the ethical, legal, and social implications of genetic technologies in healthcare.
- **Integrate genetics into clinical practice**: Discuss the role of genetics in personalized medicine, preventive health strategies, and disease management.

Course Content (Theory)		Assignments/Readings
Week 1	**Introduction to Genetics** Overview of basic genetic concepts, the history of genetics, and the impact of genetics on society.	Answer questions on the role of genetics in society.
	Introduction to Genetics Genetic terminology, scientific method in genetics, ethical considerations.	Complete a glossary of key genetic terms.
	Introduction to Genetics Ethical dilemmas in genetics, historical case studies (e.g., Eugenics, genetic screening).	Watch video on the ethics of genetic testing.
Week 2	**Mendelian Genetics** Mendel's Laws of Inheritance, monohybrid cross, and basic Punnett squares.	Problem set on monohybrid crosses.
	Mendelian Genetics Dihybrid crosses, inheritance of two traits, and Punnett square applications.	Complete dihybrid cross problems.
	Mendelian Genetics Inheritance patterns: dominance, recessive, co-dominance, incomplete dominance.	Research and present a case of co-dominance or incomplete dominance.
Week 3	**Human Chromosomes** Structure of chromosomes, karyotypes, and chromosomal abnormalities.	Read Chapter 3 and analyze a karyotype.
	Human Chromosomes Chromosomal disorders: Down syndrome, Turner syndrome, Klinefelter syndrome.	Watch video on chromosomal abnormalities and answer questions.

	Human Chromosomes Sex determination, the role of sex chromosomes (X and Y), and sex-linked traits.	Quiz on chromosomal disorders.
Week 4	**Molecular Genetics** DNA structure: double helix, nucleotides, and base pairing.	Read Chapter 4 and complete DNA structure worksheet.
	Molecular Genetics DNA replication: processes, enzymes involved, and the semi-conservative model.	Write a summary of the DNA replication process.
	Molecular Genetics Mechanisms of DNA repair, mutations, and their effects on genetic information.	Complete a mutation case study.
Week 5	**Molecular Genetics** Transcription: process of RNA synthesis, RNA polymerase, and types of RNA.	Complete transcription process diagram.
	Molecular Genetics Translation: protein synthesis, ribosomes, tRNA, and codon recognition.	Read Chapter 5, answer questions on translation.
	Molecular Genetics Gene regulation: operons, transcription factors, and eukaryotic gene regulation.	Research gene regulation in eukaryotes.
Week 6	**Genetic Variation** Types of genetic variation: mutations, polymorphisms, and their causes.	Complete worksheet on mutation types.
	Genetic Variation Genetic polymorphisms: single nucleotide polymorphisms (SNPs) and their implications.	Write a report on SNPs and their significance in human genetics.
	Genetic Variation How genetic variation arises in populations: mutation, recombination, and genetic drift.	Complete problems on Hardy-Weinberg equilibrium.
Week 7	**Population Genetics** Hardy-Weinberg equilibrium: assumptions, equation, and applications.	Quiz on Hardy-Weinberg principles.
	Population Genetics Genetic drift, founder effect, and bottleneck effect in small populations.	Review case study on genetic drift.
	Population Genetics Natural selection: how it affects genetic variation and evolution.	Submit a case study on natural selection.
Week 8	**Population Genetics** Gene flow and its impact on population genetics.	Answer questions on gene flow and human migration.
	Population Genetics Evolution: mechanism of evolution and its genetic basis.	Read Chapter 6, complete review questions.
	Population Genetics Human migration patterns and their genetic implications.	Research genetic evidence of human migration.
Week 9	**Genetics of Inheritance** Autosomal dominant and recessive inheritance patterns (examples and pedigrees).	Solve problems on autosomal inheritance patterns.
	Genetics of Inheritance Pedigree analysis and applications to inheritance of traits and disorders.	Complete pedigree analysis of a family.
	Genetics of Inheritance Autosomal and X-linked recessive inheritance patterns	Quiz on X-linked inheritance.

	(e.g., color blindness, hemophilia).	
Week 10	**Genetics of Inheritance** Mitochondrial inheritance: inheritance via maternal line.	Submit a mitochondrial inheritance case study.
	Genetics of Inheritance Inheritance of multifactorial traits (e.g., height, skin color).	Research and present a multifactorial trait example.
	Genetics of Inheritance Non-Mendelian inheritance: genomic imprinting, epigenetics.	Read articles on epigenetics and answer questions.
Week 11	**Genomics and Personalized Medicine** Introduction to genomics and its applications in healthcare.	Complete a discussion on personalized medicine.
	Genomics and Personalized Medicine Genome sequencing technologies (e.g., NGS, microarrays), and their use in diagnosis and treatment.	Research a case study on personalized genomics.
	Genomics and Personalized Medicine Pharmacogenomics: how genetic information influences drug response.	Write a report on pharmacogenomics in healthcare.
Week 12	**Genetic Disorders** Overview of genetic disorders: single-gene disorders (e.g., cystic fibrosis, sickle cell anemia).	Complete an assignment on a genetic disorder.
	Genetic Disorders Chromosomal disorders: Down syndrome, Edwards syndrome, Patau syndrome.	Watch a video on chromosomal disorders and answer questions.
	Genetic Disorders Multifactorial genetic disorders (e.g., cleft lip, type 2 diabetes).	Research and present on a multifactorial disorder.
Week 13	**Genetic Disorders** Cancer genetics: oncogenes, tumor suppressor genes, and inherited cancer syndromes.	Write a case study on inherited cancer syndromes.
	Genetic Disorders Mitochondrial diseases and their inheritance patterns.	Complete a worksheet on mitochondrial inheritance.
	Genetic Disorders Genetic testing: types (e.g., diagnostic, predictive, carrier testing), and ethical issues.	Submit a report on genetic testing and ethical considerations.
Week 14	**Ethical and Social Issues in Genetics** Ethical considerations in genetic research and testing.	Read Chapter 10 and answer ethical case study questions.
	Ethical and Social Issues in Genetics Genetic counseling: role, process, and applications in healthcare.	Complete a role-play exercise on genetic counseling.
	Ethical and Social Issues in Genetics Social implications of genetic testing, privacy, discrimination, and the future of genetics.	Write an essay on the social impact of genetic technologies.
Week 15	**Ethical and Social Issues in Genetics** Regulation of genetic technologies: laws and policies, such as genetic patenting and CRISPR regulation.	Research and present on genetic patents.
	Ethical and Social Issues in Genetics Public perception of genetics and genetic testing: societal attitudes and ethical frameworks.	Complete survey on public attitudes toward genetic testing.
	Ethical and Social Issues in Genetics Discussion: Balancing the benefits and risks of genetic technology.	Group debate on ethical issues in genetics.
Week 16	**Review and Discussion** Review of course content, major concepts, and upcoming	Prepare for the final exam.

	assessment.	
	Final Review Review of key topics: molecular genetics, inheritance, genetic disorders, and ethical/social issues.	Final exam preparation.
	Final Exam In-class exam covering all topics discussed in the course.	---

Textbooks and Reading Material

- **Human Genetics: Concepts and Applications** by Ricki Lewis
- **Genetics in Medicine** by James F. Thompson and Margaret A. S. Desnick
- **Principles of Genetics** by D. Peter Snustad and Michael J. Simmons
- **Molecular Biology of the Gene** by James D. Watson, Tania A. Baker, and Stephen P. Bell

Teaching Learning Strategies

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3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
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3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-208	Credit Hours	3(2+1)
Course Title	Cytology & Cytotechnology				

Course Introduction

The **Cytology & Cytotechnology** course introduces students to the study of cells and their functions, with a focus on diagnostic techniques used in medical laboratories. Students will learn how to prepare, stain, and examine cytological specimens, including fluids, smears, and biopsies. The course emphasizes practical skills in identifying normal and abnormal cells, particularly in the context of cancer, infections, and other diseases

Learning Outcomes

On the completion of the course, the students will:

- **Understand Cytology Basics:** Learn cell structure, function, and the role of cytology in disease diagnosis.
- **Master Cytological Techniques:** Prepare, fix, and stain cytological samples using techniques like Papanicolaou and May-Grünwald staining.
- **Identify Normal and Abnormal Cells:** Differentiate between benign and malignant cells, and recognize infection or disease-related changes.
- **Perform Clinical Procedures:** Collect and prepare samples such as sputum, urine, and body fluids for cytological analysis.
- **Apply Diagnostic Skills:** Analyze cytological slides to identify malignancy, infections, and hormonal changes

Course Content (Theory)		Assignments/Readings
Week 1	Introduction to Cytology & Cytotechnology	Overview of Cytology
	Cell Morphology and Physiology	Cell Structure and Function
Week 2	Structure and Functions of Epithelia: Lining Membrane Epithelia	Epithelial Tissue: Types and Functions
	Stratified Squamous Epithelia	Review: Articles on Stratified Squamous Epithelia
Week 3	Columnar Epithelia and Its Functions	Read: Text on Columnar Epithelial Morphology
	Epithelia Serving Reproductive Functions	Read: Chapter on Reproductive Epithelia
Week 4	Miscellaneous Epithelia	Miscellaneous Types of Epithelia
	Various Cells Seen in Cytological Preparations	Read: Chapter 5 - Cytological Cell Types
Week 5	Body Fluids: Introduction and Methods of Collection	Collection and Transport of Body Fluids
	Ascitic Fluid: Macroscopic and Microscopic Examination	Review: Articles on Ascitic Fluid Analysis
Week 6	Pleural Fluid: Collection, Transport, and Cytological Examination	Read: Research Paper on Pleural Fluid Cytology
	Synovial Fluid: Methods of Collection and Cytology	Review: Synovial Fluid Cytology Text
Week 7	Genitourinary Cytology: Normal and Abnormal	Genitourinary Cytology Basics
	Histology and Cytology of the Female Genital Tract (Childbearing Age)	Read: Text on Female Genital Tract Histology
Week 8	Cells from Normal Squamous Epithelium of Cervix and Vagina	Review: Articles on Cervical Cytology
	Squamocolumnar Junction / Transformation Zone	Read: Research on Squamocolumnar Junction

Week 9	Endocervical Epithelium and Ciliary Tufts	Review: Ciliary Tufts and Endocervical Epithelium
	Cells from Normal Endometrial Smears	Read: Chapter on Endometrial Cytology
Week 10	Non-Epithelial Cells in Normal Smears	Read: Text on Non-Epithelial Cells in Cytology
	Normal Vaginal Flora and Cyclic Changes in Vaginal Smears	Read: Articles on Vaginal Flora and Cyclic Changes
Week 11	Techniques for Vaginal Smear Collection	Review: Procedures for Vaginal Smear Collection
	Cytology of Normal Urine: Voided and Catheterized	Urine Cytology: Normal and Abnormal
Week 12	Inflammatory Processes in the Lower Urinary Tract	Read: Research on Urinary Tract Inflammation
	Bacterial, Fungal (Monilia), and Viral Infections in Urine	Read: Text on Infections and Cytology of Urinary Tract
Week 13	Cytology of Urinary Tract in Inflammation and Malignancy	Review: Articles on Cytology of Urinary Malignancy
	Cytology in the Absence of Cancer in Respiratory Tract	Read: Respiratory Cytology Basics
Week 14	Squamous and Respiratory Epithelium in Cytology	Review: Respiratory Epithelium Text
	Non-Epithelial Cells in Respiratory Tract	Read: Article on Non-Epithelial Cells in Respiratory Cytology
Week 15	Foreign Materials in Sputum	Read: Research Paper on Foreign Bodies in Sputum
	Benign Abnormalities of Respiratory Epithelium	Review: Respiratory Tract Abnormalities
Week 16	Morphologic Characteristics of Cancer Cells	Read: Cancer Cell Morphology
	Fine Needle Aspiration Cytology (FNAC)	Review: FNAC Techniques and Case Studies
Course Content (Lab)		**Assignments/Readings**
Week 1	Cytological Fixatives and Fixation	Read: Chapter on Cytological Fixation Methods. Assignment: Prepare a report on different fixatives and their applications in cytology.
Week 2	Collection and Preparation of Fluid Sediment for Cytological Examination	Read: Chapter on Fluid Cytology. Assignment: Demonstrate the collection and preparation of body fluids for cytology.
Week 3	Preparation and Fixation of Sputum Smears for Cytology	Review: Sputum Smear Preparation Techniques. Assignment: Prepare sputum smears and perform fixation.
Week 4	Preparation and Fixation of Vaginal and Cervical Smears for Cytology	Read: Article on Vaginal and Cervical Smear Preparation. Assignment: Prepare and fix cervical and vaginal smears.
Week 5	Hormonal Evaluation of Vaginal Smears	Read: Hormonal Cycles and Cytology. Assignment: Analyze hormonal changes in vaginal smears

		based on cytological findings.
Week 6	Papanicolaou Staining - Principles and Staining Procedures	Read: Chapter on Papanicolaou Staining. Assignment: Perform Papanicolaou staining on a given smear and record observations.
Week 7	May-Grünwald Staining - Principles and Staining Procedures	Read: May-Grünwald Staining Procedure. Assignment: Perform May-Grünwald staining on slides and compare with Papanicolaou stain.
Week 8	Identification of Cells	Read: Chapter on Cytological Cell Types. Assignment: Identify and classify different types of cells in prepared smears.
Week 9	Differentiation Between Malignant and Benign Cells	Read: Text on Malignant vs. Benign Cells. Assignment: Practice differentiating malignant and benign cells in cytological slides.
Week 10	Cytological Examination of Ascitic Fluid	Read: Research on Ascitic Fluid Cytology. Assignment: Prepare slides and analyze ascitic fluid for normal and abnormal cells.
Week 11	Cytological Examination of Pleural Fluid	Review: Cytology of Pleural Fluid. Assignment: Prepare pleural fluid slides and identify key cytological markers.
Week 12	Cytological Examination of Synovial Fluid	Read: Chapter on Synovial Fluid Analysis. Assignment: Prepare and analyze synovial fluid slides for normal and abnormal cytology.
Week 13	Cytology of Urine – Voided and Catheterized	Read: Chapter on Urine Cytology. Assignment: Prepare urine smears and identify cells, including malignant cells.
Week 14	Cytological Examination of Sputum for Infection and Malignancy	Read: Sputum Cytology in Infection and Cancer. Assignment: Review sputum slides for signs of infection or malignancy.
Week 15	Fine Needle Aspiration Cytology (FNAC) Procedure	Read: FNAC Procedure and Principles. Assignment: Simulate FNAC procedures on model specimens and practice slide preparation.
Week 16	Case Study: Diagnosis Using Cytology	Read: Case Studies in Cytology. Assignment: Analyze prepared slides and diagnose based on cytological findings.
Textbooks and Reading Material		
• Diagnostic cytology and its Histopathological Basis-Vol-1-E.G.Koss • Suvarna SK, Layton C, Bancroft JD. Bancroft's Theory and Practice of Histological Techniques, Expert Consult: Online and Print, 7: Bancroft's Theory and Practice of Histological Techniques. Elsevier Health Sciences; 2013.		

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   To practice persuasive speaking, public speaking, and informal conversations.
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3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-301	Credit Hours	3(2+1)
Course Title	Medical Virology				

Course Introduction

This **course** offers an in-depth exploration of the various families of human viruses, with a primary focus on those that infect humans and lead to significant diseases. Emphasis will be placed on understanding the pathogenesis and mechanisms of viral infections, as well as virus-cell interactions at both the cellular and molecular levels. The course includes lectures, readings, and discussions of primary research papers, covering topics such as viral entry, DNA/RNA replication, transcription, translation, virus assembly and release, persistence, latency, cell lysis, and viral interference. Additionally, practical sessions will provide hands-on experience with classical biological techniques, including basic cell culture.

Learning Outcomes

On the completion of the course, the students will:

- **Understand Virus Families**: Identify and classify various families of human viruses and their relevance to human health.
- **Explain Pathogenesis Mechanisms**: Describe the pathogenesis of viral infections, including the cellular and molecular mechanisms involved in virus entry, replication, transcription, translation, and release.
- **Analyze Viral Interactions**: Evaluate virus-cell interactions and their impact on the host, including viral persistence, latency, and mechanisms of cell damage (lysis and interference).
- **Critically Review Research**: Analyze and interpret primary research papers related to viral infections and virus-host interactions.
- **Apply Biological Techniques**: Demonstrate proficiency in classical biological techniques, such as basic cell culture, used to study viruses.
- **Evaluate Viral Impact**: Assess the clinical and public health implications of viral diseases, focusing on serious infections and emerging viral threats.
- **Integrate Knowledge Across Disciplines**: Synthesize knowledge from molecular biology, virology, and cell biology to understand the full scope of viral pathogenesis and treatment strategies.

	Course Content (Theory)	Assignments/Readings
Week 1	**Introduction to Medical Virology** Definition, scope, and significance of medical virology. Historical developments and milestones in virology.	Read: Principles of Virology Discuss historical milestones (e.g., discovery of viruses, viral pathogenesis).
	Introduction to Medical Virology (contd.) Classification of viruses and their nomenclature.	Read: Fields Virology Assignment: Review the taxonomy of different viral families.
Week 2	**Viral Structure and Replication** Structure of viruses: capsid, envelope, genome. Types of viruses: DNA, RNA, enveloped, non-enveloped.	Read: Medical Microbiology – Chapter on Virus Structure. Quiz on virus classification and structure.
	Viral Replication Cycles Lytic, lysogenic, and chronic infections. Mechanisms of viral entry, uncoating, and release.	Read: Molecular Virology – Chapter on Virus Replication. Watch a video on viral replication cycles.
Week 3	**Host-Virus Interactions and Pathogenesis** Cellular tropism and host range of viruses.	Read: Principles of Virology – Chapter on Host-Virus Interaction. Case study review on viral tropism (e.g., HIV, influenza).
	Host-Virus Interactions and Pathogenesis (contd.) Mechanisms of viral pathogenesis: immune evasion, tissue damage, and oncogenesis.	Read: Virus Pathogenesis Assignment: Review immune evasion strategies by different viruses.

Week 4	**Viral Latency, Reactivation, and Persistence** Mechanisms of latency and persistence. Examples of viruses with latent infection (e.g., Herpesviruses).	Read: Molecular Virology – Chapter on Viral Latency. Discussion: Compare and contrast latent vs active viral infections.
	Clinical Manifestations of Viral Infections Overview of common viral infections and their clinical presentations.	Read: Medical Microbiology – Clinical aspects of viral infections. Prepare a report on clinical manifestations of influenza and measles.
Week 5	**Clinical Diagnosis of Viral Infections** Diagnostic methods: serology, molecular techniques, and microscopy.	Read: Clinical Virology – Diagnostic techniques in virology. Practice: Review diagnostic techniques for Hepatitis C.
	Clinical Diagnosis (contd.) Interpretation of viral load and antibody titers.	Read: Virology Methods Manual – Chapter on diagnostic tests. Case study analysis: Interpretation of viral load in HIV diagnosis.
Week 6	**Antiviral Agents and Treatment Strategies** Types and modes of action of antiviral agents.	Read: Antiviral Therapy – Chapter on antiviral drugs. Assignment: Review antiviral drugs for Herpesvirus infections.
	Antiviral Agents (contd.) Challenges in antiviral drug development.	Read: Antiviral Therapy – Challenges in drug discovery. Discussion: Challenges in the development of drugs for emerging viruses.
Week 7	**Immunization Strategies** Vaccines and their importance in preventing viral infections.	Read: Vaccine Immunology – Chapter on Viral Vaccines. Research on recent vaccine development (e.g., mRNA vaccines for COVID-19).
	Emerging and Re-emerging Viral Infections Zoonotic viruses and spillover events. Overview of emerging viruses (e.g., SARS-CoV-2, Ebola).	Read: Emerging Infectious Diseases – Zoonotic viruses. Case study: Ebola and Zika outbreaks.
Week 8	**Surveillance and Management of Outbreaks** Importance of surveillance systems and outbreak management.	Read: Global Health and Infectious Disease – Chapter on viral surveillance. Assignment: Create an outbreak management plan for a fictional virus.
	Public Health Implications of Viral Infections Impact of viral infections on public health.	Read: Epidemiology of Infectious Diseases – Viral impacts on public health. Discussion on the global burden of viral infections.
Week 9	**Prevention and Control of Viral Infections** Epidemiology and strategies for viral infection prevention.	Read: Public Health and Disease Prevention – Viral infection control strategies. Prepare a report on the role of public health in controlling viral outbreaks.
	Prevention (contd.)	Read: Infectious Disease

	Importance of hygiene, vaccination, and public awareness.	Epidemiology – Chapter on prevention. Assignment: Discuss how vaccination and hygiene prevent outbreaks.
Week 10	**Research in Medical Virology** Overview of current research areas in medical virology.	Read: Research in Virology – Recent advances in virology research. Research paper on the latest virology innovations (e.g., antiviral resistance).
	Laboratory Techniques in Virology Basic laboratory techniques in virology research. PCR, viral culture, and electron microscopy.	Read: Virology Lab Manual – Techniques in virus isolation and identification. Lab demonstration: Basic PCR and viral culture techniques.
Week 11	**Exploring Career Paths in Virology** Potential careers in virology and related fields.	Read: Careers in Infectious Disease – Career paths in virology. Assignment: Create a career plan in the field of virology.
	Case Study: Influenza and Other Respiratory Viruses Clinical and diagnostic overview.	Read: Clinical Virology – Respiratory viral infections. Group work: Study the epidemiology of influenza outbreaks.
Week 12	**Case Study: Hepatitis Viruses** Diagnosis, treatment, and vaccination strategies.	Read: Hepatitis: A Clinical Guide – Hepatitis diagnosis and prevention. Discuss: Hepatitis B and C management.
	Case Study: Herpesviruses Latency, reactivation, and clinical outcomes.	Read: Herpesviruses – Mechanisms of latency and treatment. Presentation: Discuss Herpes Simplex Virus and Varicella Zoster Virus.
Week 13	**Zoonotic Diseases and Emerging Viruses** Understanding zoonoses and cross-species transmission.	Read: Zoonotic Infections – Chapter on viral spillover. Research: Identify key zoonotic viruses and their transmission dynamics.
	Emerging Viruses: HIV and Hepatitis C Molecular mechanisms and treatment strategies.	Read: HIV and Hepatitis C: Clinical Updates. Group discussion: Current treatments for HIV and Hepatitis C.
Week 14	**Case Study: Viral Oncogenesis** Mechanisms of cancer development by viruses.	Read: Viral Oncology – Chapter on oncogenic viruses. Prepare a report on oncogenic viruses (e.g., HPV, Hepatitis B).
	Prevention and Control of Emerging Infections Case studies on surveillance and control strategies.	Read: Global Viral Threats – Prevention and containment strategies.

		Class discussion: Preventing future viral pandemics.
Week 15	**Antiviral Drug Resistance** Mechanisms of resistance and strategies to overcome it.	Read: Antiviral Drug Resistance – Mechanisms and management.
	Vaccine Development Challenges and innovations in vaccine development.	Read: Vaccines – Challenges in viral vaccine development. Group project: Develop a proposal for a new vaccine against an emerging virus.
Week 16	**Current Trends in Virology Research** Advances in virology techniques and future directions.	Read: Advances in Virology – Latest trends in research. Presentation: Discuss a recent virology research paper.
	Course Review and Wrap-up Review key concepts and discuss the future of virology research.	Final Exam Review. Final assignment: Submit research paper on a current viral threat.
Course Content (Lab)		**Assignments/Readings**
Week 1	**Introduction to Lab Work and Data Collection** • Overview of data collection methods. • Select a research question and begin primary data collection.	• Read: Statistical Methods for Research –Introduction to Data Collection. • Assignment: Develop a plan for data collection.
Week 2	**Data Cleaning and Editing** • Identify and rectify errors in collected data. • Clean the data for analysis.	• Read: Data Science for Beginners – Chapter on Data Cleaning. • Assignment: Edit a dataset and document changes.
Week 3	**Data Presentation (Tabular Formats)** • Learn to organize and present data in tabular format using Excel or SPSS.	• Read: Microsoft Excel for Data Analysis – Basic functions and table creation. • Assignment: Present data in tabular form.
Week 4	**Data Presentation (Visual Formats)** • Create bar graphs, pie charts, and scatter plots. • Visualize data trends and distributions.	- Read: SPSS for Data Analysis – Creating visualizations. - Assignment: Generate at least two different visualizations for your data.
Week 5	**Measures of Central Tendency** • Calculate arithmetic mean, geometric mean, harmonic mean, and mode for real datasets.	• Read: Applied Statistics for Data Science – Measures of central tendency. • Assignment: Calculate and interpret mean, median, and mode for a given dataset.
Week 6	**Measures of Dispersion** • Compute range, variance, and standard deviation for given data.	• Read: Statistics for Business and Economics – Measures of dispersion. • Assignment: Calculate and analyze variance and standard deviation for a dataset.
Week 7	**Correlation Analysis** • Calculate correlation coefficients (Pearson, Spearman) for real datasets.	• Read: Understanding Correlation – Statistical correlations and their

	• Interpret correlation results.	significance. • Assignment: Perform correlation analysis between two datasets.
Week 8	**Regression Analysis** • Perform simple linear regression using the least squares method. • Interpret regression coefficients and R-squared values.	• Read: Applied Regression Analysis – Linear regression techniques. • Assignment: Conduct a regression analysis and interpret the results.
Week 9	**Probability Distributions** • Simulate binomial and Poisson distributions using random number generators. • Create histograms to visualize distributions.	• Read: Probability and Statistics for Engineers – Probability distributions. • Assignment: Simulate binomial and Poisson distributions and visualize them.
Week 10	**Sampling Techniques** • Practice random sampling and systematic sampling techniques. • Analyze the advantages and disadvantages of each method.	• Read: Sampling Techniques – Chapter on Random and Systematic Sampling. • Assignment: Implement both sampling techniques and compare results.
Week 11	**Hypothesis Testing: Introduction** • Formulate null and alternative hypotheses based on a given research question.	• Read: Principles of Statistical Inference – Hypothesis testing basics. • Assignment: Formulate hypotheses for a research scenario.
Week 12	**Hypothesis Testing: Chi-Square and t-test** • Perform chi-square tests and t-tests using real data. • Interpret results of hypothesis tests.	• Read: Hypothesis Testing in Practice – Chi-square and t-tests. • Assignment: Perform chi-square and t-test on provided datasets.
Week 13	**Hypothesis Testing: ANOVA** • Conduct Analysis of Variance (ANOVA) on multiple group data.	• Read: Introduction to ANOVA – ANOVA methods and interpretations. • Assignment: Perform one-way ANOVA and report results.
Week 14	**SPSS Practical: Basic Functions** • Import and clean datasets in SPSS. • Calculate basic statistical measures using SPSS.	• Read: SPSS for Beginners – Overview of SPSS functions and analysis tools. • Assignment: Import and clean a dataset using SPSS.
Week 15	**SPSS Practical: Advanced Functions** • Perform chi-square tests, t-tests, and ANOVA in SPSS. • Analyze data using SPSS output.	• Read: Advanced SPSS Techniques – Conducting statistical tests with SPSS. • Assignment: Use SPSS to perform chi-square, t-tests, and ANOVA on provided data.

Week 16	**Real-World Application and Report Writing** • Analyze a practical case study using statistical techniques. • Prepare a comprehensive report on findings and interpretations.	• Read: Statistical Analysis and Reporting – Writing a data analysis report. • Assignment: Submit a final report on the case study, including methods, analysis, and conclusions.

Textbooks and Reading Material

- Lopez, L., & Martinez-Sobrido, L. (2020). *Emerging and Re-Emerging Viral Pathogens: Fundamental and Basic Virology Aspects of Human, Animal and Plant Pathogens* . Academic Press.
- Cann, A. J., &Carr, D. J.. (2021). *Principles of Molecular Virology*. Elsevier.
- Fields, B. N., Knipe, D. M., & Howley, P. M. (2013). *Fields Virology*. Lippincott Williams & Wilkins.
- Kawaoka, Y. (2019). *Textbook of Influenza*. Springer.
- Mahy, B. W. J., & Van Regenmortel, M. H. V. (2020). *Encyclopedia of Virology*. Academic Press.
- Murphy, F. A., Gibbs, E. P. J., Horzinek, M. C., &Studdert, M. J. (2016). *Veterinary Virology*. Academic Press.
- Zuckerman, A. J., Banatvala, J. E., Schoub, B. D., Griffiths, P. D., & Mortimer, P. (2013). *Principles and Practice of Clinical Virology*. John Wiley & Sons.
- Cohen, J. I. (Ed.). (2020). *Clinical Virology Manual*. ASM Press.

Teaching Learning Strategies

1. **Interactive Lectures**
   Engage students with interactive presentations, discussions, and real-time corrections of writing and speaking errors.
2. **Collaborative Learning**
   Students will work in pairs or small groups to write essays, analyze readings, and give peer feedback on presentations.
3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-302	Credit Hours	3(2+1)
Course Title	**Clinical Bacteriology & Mycology**				

Course Introduction

This course introduces **Clinical Bacteriology** & **Mycology**, focusing on the identification, diagnosis, and management of bacterial and fungal infections. **Mycology**, the study of fungi, covers their genetics, taxonomy, biomedical roles, and clinical significance. Fungi have important uses in medicine (e.g., antibiotics), food (e.g., fermentation), and industry. However, they can also cause infections (e.g., candidiasis) and produce harmful mycotoxins. Students will gain hands-on laboratory experience to diagnose and treat infections in clinical settings.

Learning Outcomes

On the completion of the course, the students will:

1. **Identify and Classify Pathogens**: Recognize key bacteria and fungi, and understand their clinical significance.
2. **Demonstrate Diagnostic Skills**: Perform lab techniques to identify bacterial and fungal infections, including culturing and microscopy.
3. **Understand Fungal Roles**: Discuss the benefits and hazards of fungi in medicine, food, and health (e.g., infections and mycotoxins).
4. **Analyze and Treat Infections**: Identify and manage common fungal infections in clinical practice.
5. **Understand Resistance Mechanisms**: Explore antimicrobial resistance in both bacteria and fungi.
6. **Interpret Lab Data**: Apply laboratory results to diagnose and manage infections effectively in Allied Health practice

Course Content (Theory)		Assignments/Readings
Week 1	Introduction to Clinical Bacteriology: Overview and Importance	Read: Introduction to Microbiology
	Pathogenicity of Staphylococcus aureus: Mechanisms and Clinical Features	Review articles on Staphylococcus aureus pathogenesis
Week 2	Laboratory Diagnosis of Staphylococcus aureus	Lab exercises on bacterial culture techniques
	Coagulase-negative Staphylococci: Characteristics and Clinical Significance	Read Chapter on Coagulase-negative Staphylococci
Week 3	Beta-hemolytic Streptococci: Identification and Pathogenicity	Case studies on Beta-hemolytic Streptococci infections
	Alpha-hemolytic Streptococcus and Streptococcus pneumoniae	Diagnostic tests for Streptococcus species
Week 4	Enterococci: Pathogenicity and Resistance Mechanisms	Research on enterococci resistance mechanisms
	Bacillus Species (B. anthracis, B. cereus)	Laboratory identification of Bacillus species
Week 5	Clostridium Species: C. tetani, C. botulinum, C. perfringens, C. difficile	Review of Clostridium pathogenesis
	Corynebacterium diphtheriae and Listeria monocytogenes	Case study on diphtheria and listeriosis
Week 6	Neisseria Species (N. meningitidis, N. gonorrhoeae): Pathogenesis and Diagnosis	Study of Neisseria infections and diagnostic methods
	Enteric Bacteria: Escherichia coli, Klebsiella, Enterobacter, Citrobacter	Laboratory diagnosis of enteric bacteria
Week 7	Salmonella, Shigella, Proteus: Clinical Features and Pathogenesis	Review Salmonella and Shigella outbreaks
	Campylobacter, Helicobacter, and Vibrio Species: Identification and Pathogenesis	Reading on Helicobacter pylori and gastrointestinal infections

Week 8	Haemophilus, Bordetella, and Legionella: Identification and Diagnosis	Study of respiratory pathogens and diagnostic techniques
	Brucella, Francisella, Pasteurella: Clinical Features and Diagnosis	Read on zoonotic infections caused by Brucella and Francisella
Week 9	Pseudomonas, Rickettsia, Chlamydia trachomatis: Pathogenesis and Diagnosis	Assignment on Pseudomonas aeruginosa infections
	Bacteroides, Mycobacteria, Treponema pallidum, Leptospira, Borrelia	Lab diagnosis and molecular techniques for spirochetes
Week 10	Mycoplasma: Characteristics and Clinical Relevance	Study Mycoplasma infections and treatment methods
	Molecular Methods in Bacterial Diagnosis: PCR and Other Techniques	Practical assignment on PCR techniques for bacterial identification
Week 11	Immunological Methods in Bacterial Diagnosis: ELISA, Western Blot	Read on immunological assays in microbiology
	Antibacterial Drugs: Modes of Action and Mechanisms	Read and summarize chapters on antibiotic classes
Week 12	Antimicrobial Resistance: Mechanisms and Implications	Case study on antibiotic resistance and its clinical impact
	Basic Structure and Growth of Fungi	Review of fungal cell structures and growth requirements
Week 13	Fungal Pathogenesis and Clinical Features	Research on fungal infections and their impact on health
	Culture Requirements of Fungal Pathogens	Practical lab work on culturing fungal species
Week 14	Laboratory Diagnosis of Fungal Infections	Study fungal diagnostic techniques (KOH prep, culture, etc.)
	Life Cycle of Fungi and Pathogenesis	Read on fungal life cycles and how they relate to disease
Week 15	Candida and Aspergillus: Pathogenesis and Diagnosis	Case studies on Candida and Aspergillus infections
	Histoplasma, Cryptococcus, and Coccidioides: Fungal Infections	Study of systemic fungal infections and their diagnostic methods
Week 16	Antifungal Drugs: Mechanisms and Resistance	Review of antifungal drug classes and their actions
	Dermal Fungal Infections: Diagnosis and Treatment	Read on dermatophyte infections and antifungal therapy
Course Content (Lab)		**Assignments/Readings**
Week 1	Introduction to Lab Techniques: Overview of Bacterial Identification	Review of general bacterial lab techniques
Week 2	Identification of Staphylococci: Morphology, Gram Stain, Biochemical Tests	Practical exercise on Staphylococcus identification
Week 3	Identification of Streptococci: Biochemical Tests (Catalase, Coagulase)	Prepare a report on biochemical tests for Streptococci
Week 4	Identification of Enterobacteria ceae: Use of Enterotube, Biochemical Tests	Lab work on Enterobacteria ceae identification
Week 5	Identification of Pseudomonas Species: Morphology and Biochemical Testing	Case study on Pseudomonas infections
Week 6	Identification of Vibrio Species: Culture, Biochemical Tests (Glucose, Lactose Fermentation)	Review biochemical tests for Vibrio identification
Week 7	Catalase, Coagulase, and DNAse Tests: Practical Application	Prepare results from lab tests for Staphylococci

Week 8	Citrate Utilization, Glucose Fermentation, and Lactose/Sucrose Fermentation Tests	Hands-on practice with biochemical media for bacterial fermentation tests
Week 9	Methyl Red, Urease, and Voges-Proskauer Tests: Practical Demonstration	Report on MRVP, Urease tests for bacterial identification
Week 10	Multiple Test Systems (e.g., 20E): Practical Application	Conduct tests using commercial kits for bacterial identification
Week 11	Introduction to Fungal Identification Techniques: KOH Preparation	Prepare and identify fungi from clinical samples using KOH method
Week 12	Block Agar Technique for Fungal Isolation	Lab practice on fungal isolation using Block Agar technique
Week 13	Hanging Drop Method for Fungal Identification	Prepare slides using the hanging drop technique to observe fungal morphology
Week 14	Nail and Hair Preparation for Fungal Analysis	Perform and analyze fungal cultures from nails and hair samples
Week 15	Fungal Growth on Sabouraud Dextrose Agar (SDA)	Observe fungal growth and colony morphology on SDA plates
Week 16	Germ Tube Preparation: Identification of Candida Species	Prepare and identify germ tubes for Candida species

Textbooks and Reading Material

- Deacon, J. W. (2018). *Fungal Biology*. John Wiley & Sons.
- Cheesbrough M. District laboratory practice in tropical countries. Cambridge university press; 2006
- Crocker J, Burnett D, The Science of laboratory diagnosis. John Wiley & Sons; 2005. Ridley J. Essentials of Clinical Laboratory Science. Delmar Cengage Learning; 2010.
- Gillespie S, Hawkey PM, editors. Principles and practice of clinical bacteriology. John Wiley & Sons; 2006.
- Leboffe MJ, Pierce BE. Microbiology: laboratory theory and application. Morton Publishing Company; 2012.

Teaching Learning Strategies

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3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

Quiz-1, Quiz-II, Presentation, Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details

1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-303	Credit Hours	3(2+1)
Course Title	Biostatistics				

Course Introduction

Statistics is the science of collecting, analyzing, interpreting, and presenting numerical data. When applied to living organisms, it is referred to as *biostatistics*. Biologists use biostatistics to address research questions in medicine, such as identifying the underlying causes of diseases, estimating life expectancy for individuals with chronic conditions, or determining the factors that can extend a patient's survival.

Learning Outcomes

On the completion of the course, the students will:

- **Demonstrate proficiency in statistical concepts**: Understand and explain core statistical principles and methods used in biostatistics.
- **Apply biostatistical techniques**: Use appropriate statistical methods to analyze and interpret biological and medical data in various research contexts.
- **Analyze and interpret data confidently**: Conduct data analysis using statistical software, and interpret results accurately for biological and medical studies.
- **Evaluate research critically**: Assess the validity of statistical methods used in biological and medical research, identifying limitations and potential biases.
- **Communicate statistical results effectively**: Present statistical findings clearly through reports, tables, charts, and graphs, making them accessible to both experts and non-experts.
- **Understand ethical and practical considerations**: Address ethical issues in data collection, analysis, and interpretation, ensuring integrity in biostatistical research.
- **Integrate biostatistics into decision-making**: Apply statistical analysis to make informed decisions in public health, medicine, and healthcare policy.
- **Contribute to evidence-based healthcare**: Use biostatistical knowledge to support research, policy-making, and patient care through scientifically grounded insights.

Course Content (Theory)		Assignments/Readings
Week 1	Introduction to Biostatistics and its scope.	Read: Introduction to Biostatistics.
	Collection of primary and secondary data.	Read: Data Collection Methods.
Week 2	Editing of data.	Complete exercises on data editing.
	Presentation of data: tabulation, classification, visual presentation (diagrams and graphs in Microsoft Excel).	Practice creating data tables and graphs in Excel.
Week 3	Presentation of data in SPSS.	SPSS tutorial: Data presentation in SPSS.
	Measures of central tendency: Arithmetic Mean by direct and shortcut method.	Complete problems on calculating arithmetic mean.
Week 4	Measures of central tendency: Geometric Mean, Harmonic Mean, Mode, Median, ED50 (LD50 in detail), Quantile.	Read and solve exercises on measures of central tendency.
	Measures of dispersion: Range, Quartile Deviation, Mean Deviation.	Practice calculating range and deviation measures.
Week 5	Measures of dispersion: Standard Deviation (direct and shortcut method), Variance, and their Coefficients.	Solve problems on standard deviation and variance.
	Correlation: Simple correlation table, Rank correlation.	Read: Correlation and solve related problems.
Week 6	Correlation: Partial and Multiple correlations.	Complete assignments on partial and multiple correlations.
	Regression and method of least squares.	Solve problems on regression and least squares method.

Week 7	Probability: Concept of probability, Laws of probability.	Read: Basics of Probability.
	Permutation and combination, Probability distributions.	Complete exercises on permutations, combinations, and probability.
Week 8	Binomial distribution and its fitting to observed data.	Solve problems on binomial distribution.
	Poisson distribution and its fitting to observed data.	Read and practice problems on Poisson distribution.
Week 9	Normal distribution and its application.	Solve problems on normal distribution.
	Sampling methods and basic design.	Read: Sampling Techniques and Design.
Week 10	Hypothesis testing: Introduction and concepts.	Complete exercises on hypothesis testing.
	Chi-square test: Concepts and application.	Read: Chi-square tests and solve problems.
Week 11	Student's t-test: Concepts and application.	Solve problems on t-test.
	Analysis of Variance (ANOVA): One-way ANOVA.	Complete exercises on one-way ANOVA.
Week 12	Two-way ANOVA and its application.	Practice problems on two-way ANOVA.
	How to use SPSS: Importing data, Frequency calculation.	SPSS tutorial: Import data and calculate frequencies.
Week 13	SPSS: Mean, Mode calculations in SPSS.	Practice calculating mean and mode in SPSS.
	SPSS: Chi-square test in SPSS.	Solve chi-square problems using SPSS.
Week 14	SPSS: t-test in SPSS.	Practice conducting t-test in SPSS.
	SPSS: ANOVA in SPSS.	Solve ANOVA problems using SPSS.
Week 15	Review of key biostatistical concepts and techniques.	Complete review exercises on biostatistical methods.
	Practical session: SPSS for data analysis (Hands-on practice).	Submit assignment on SPSS data analysis.
Week 16	Case study and application of biostatistics in healthcare.	Read case study and prepare a report.
	Course wrap-up and final assessment.	Review course materials and prepare for final exam.
Course Content (Lab)		**Assignments/Readings**
Week 1	**Data Collection and Editing**: Collect primary data related to a research question; clean and edit data by identifying and correcting errors.	Practice data collection and data editing exercises.
Week 2	**Data Presentation**: Create tabular presentations in Microsoft Excel or SPSS; generate bar graphs, pie charts, and scatter plots to represent data visually.	Submit data presentation tasks using Excel or SPSS.
Week 3	**Measures of Central Tendency**: Calculate arithmetic mean, geometric mean, harmonic mean, and mode using real datasets.	Solve exercises on calculating measures of central tendency.
Week 4	**Measures of Dispersion**: Compute range, variance, and standard deviation for data samples.	Complete problems on dispersion measures.

Week 5	**Correlation Analysis**: Calculate correlation coefficients (e.g., Pearson, Spearman) and interpret their strength and direction.	Practice calculating and interpreting correlation coefficients.
Week 6	**Regression Analysis**: Perform simple linear regression analysis using the method of least squares.	Submit regression analysis reports using real data.
Week 7	**Probability Distributions**: Simulate binomial and Poisson distributions using random number generators; create histograms for data visualization.	Complete exercises on binomial and Poisson distributions.
Week 8	**Sampling Techniques**: Practice random sampling and systematic sampling on a given dataset; discuss advantages and disadvantages of different sampling methods.	Submit a report on sampling techniques and their applications.
Week 9	**Hypothesis Testing**: Formulate null and alternative hypotheses for a research question; perform chi-square tests on real data.	Perform chi-square tests and submit the results.
Week 10	**Hypothesis Testing**: Conduct t-tests on real data for comparing means.	Complete exercises on t-tests using real-world datasets.
Week 11	**Hypothesis Testing**: Conduct one-way and two-way ANOVA tests to compare group means.	Solve problems on one-way and two-way ANOVA.
Week 12	**SPSS Usage**: Import datasets into SPSS; calculate basic statistical measures using SPSS functions.	Import a dataset into SPSS and perform basic analysis.
Week 13	**SPSS Usage**: Perform chi-square tests, t-tests, and ANOVA using SPSS software.	Practice conducting chi-square, t-test, and ANOVA in SPSS.
Week 14	**Real-world Application**: Analyze a case study or practical scenario involving real data; apply appropriate statistical tests to draw conclusions.	Analyze a real-world case study and prepare a report.
Week 15	**Report Writing**: Prepare a comprehensive report detailing steps taken, calculations, and results obtained in each practical task.	Submit a comprehensive lab report summarizing all tasks.
Week 16	**Final Review and Discussion**: Review and discuss the application of biostatistical techniques to real-world problems; finalize report writing.	Submit the final report and prepare for the lab assessment.

Textbooks and Reading Material

- Pagano, M., & Gauvreau, K. (2018). *Principles of Biostatistics*. Cengage Learning.
- Glantz, S. A., & Slinker, B. K. (2017). *Primer of Applied Regression & Analysis of Variance*. McGraw-Hill Education.
- Dawson, B., & Trapp, R. G. (2018). *Basic & Clinical Biostatistics*. McGraw-Hill Education.
- Sullivan, L. M. (2017). *Essential Biostatistics: A Nonmathematical Approach*. Jones & Bartlett Learning.
- Ghasemi, A., & Zahediasl, S. (2019). *Normality Tests for Statistical Analysis: A Guide for Non-Statisticians*. Academic Press.
- Rosner, B. (2019). *Fundamentals of Biostatistics*. Cengage Learning.
- Aho, K., & Derryberry, D. (2018). *Statistics and Data Analysis for Microarrays Using R and Bioconductor*. CRC Press.
- Bland, M. (2019). *An Introduction to Medical Statistics*. Oxford University Press.

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   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-304	Credit Hours	3(2+1)
Course Title	Biomedical Instrumentation				

Course Introduction

The **Biomedical Instrumentation** course is a comprehensive learning experience designed to provide bachelor's students with a thorough understanding of the medical instruments used in both clinical and research laboratories. Through a blend of theoretical learning and practical hands-on sessions, students will gain proficiency in operating, maintaining, and troubleshooting a variety of medical laboratory instruments. Additionally, students will learn how to interpret and analyze data generated by these instruments while adhering to ethical standards and safety protocols. The course also ensures that students stay informed about the latest developments and advancements in the field of biomedical instrumentation.

Learning Outcomes

On the completion of the course, the students will:

- Operate a variety of medical laboratory instruments effectively.
- Perform maintenance and troubleshoot biomedical instruments.
- Interpret and analyze data generated by laboratory instruments.
- Adhere to safety protocols and ethical guidelines in the laboratory.
- Stay updated with advancements in biomedical instrumentation technology.
- Solve problems related to biomedical instruments and lab operations.
- Communicate technical information clearly to both technical and non-technical audiences.
- Apply biomedical instrumentation knowledge to real-world clinical and research scenarios.

Course Content (Theory)		Assignments/Readings
Week 1	**Introduction to Biomedical Instrumentation**: Overview of biomedical instruments in healthcare, their importance, and impact on diagnostics and patient care.	Read: Introduction to Biomedical Instrumentation.
	Types of Biomedical Instruments: Classification of biomedical instruments—diagnostic, therapeutic, and monitoring devices.	Assignment: Write a report on the different types of biomedical instruments and their applications.
Week 2	**Measurement Principles in Biomedical Instruments**: Overview of basic physical principles (e.g., electrical, mechanical, optical) and measurement techniques.	Read: Measurement Principles in Biomedical Instruments.
	Units of Measurement: Common units in biomedical instrumentation (e.g., voltage, resistance, pressure, pH) and conversion methods.	Assignment: Prepare a list of units and their application in biomedical instruments.
Week 3	**Calibration of Biomedical Instruments**: The role of calibration in ensuring accurate measurements; methods of calibration and traceability.	Read: Calibration Techniques and Standards.
	Accuracy, Precision, Sensitivity, and Specificity: Definitions, differences, and importance in instrument performance and diagnostics.	Assignment: Solve problems related to accuracy and precision in instrumentation.
Week 4	**Microscopes and Imaging Systems**: Principles and operation of light microscopes, fluorescence microscopes, and advanced imaging systems.	Read: Microscopy in Biomedical Applications.
	Spectrophotometry and Photometry: Principles of light absorption and transmittance; applications of spectrophotometers and photometers in clinical diagnostics.	Assignment: Case study on the application of spectrophotometry in healthcare.
Week 5	**Centrifugation Techniques**: Principles of centrifugal force, types of centrifuges, and their applications in biological sample separation.	Read: Centrifugation Techniques in Biomedical Laboratories.

	Gel Electrophoresis: Basic principles of gel electrophoresis for separating DNA, RNA, and proteins.	Assignment: Write a detailed report on gel electrophoresis and its clinical applications.
Week 6	**ECG and EEG Systems**: Overview of electrocardiography (ECG) and electroencephalography (EEG) systems, principles of operation, and clinical significance.	Read: Principles of ECG and EEG Systems.
	Patient Monitoring Systems: Introduction to pulse oximeters, blood pressure monitors, and temperature sensors, their principles of operation, and clinical uses.	Assignment: Compare and contrast different patient monitoring systems.
Week 7	**Real-Time PCR (Polymerase Chain Reaction)**: Principles of PCR, its biomedical applications, and real-time PCR systems for genetic diagnostics.	Read: Introduction to Real-Time PCR.
	Flow Cytometry: Basic principles of flow cytometry, cell sorting, and its application in medical diagnostics.	Assignment: Prepare a report on the uses of flow cytometry in clinical settings.
Week 8	**Mass Spectrometry**: Principles of mass spectrometry, its use in biomedical analysis, and examples of clinical applications such as drug testing and proteomics.	Read: Mass Spectrometry in Biomedical Analysis.
	Next-Generation Sequencing (NGS): Overview of NGS technologies, applications in genomic medicine, and their role in personalized healthcare.	Assignment: Case study on the role of NGS in the diagnosis of genetic disorders.
Week 9	**Ethical Considerations in Biomedical Instrumentation**: Ethical issues related to the development, use, and regulation of medical instruments.	Read: Bioethics in Medical Instrumentation.
	Regulatory Standards for Medical Devices: Overview of global regulatory standards (e.g., FDA, ISO) for medical devices, including quality control and compliance.	Assignment: Research paper on regulatory standards for medical instruments.
Week 10	**Biomedical Instrumentation in Personalized Medicine**: Role of instrumentation in personalized diagnostics and treatment.	Read: Biomedical Instrumentation and Personalized Medicine.
	Emerging Trends in Biomedical Instrumentation: Innovations in wearable medical devices, biosensors, and AI applications in healthcare.	Assignment: Report on emerging technologies in biomedical instrumentation.
Week 11	**Patient Safety and Instrumentation**: Focus on safety protocols, risk management, and best practices for using biomedical instruments in clinical settings.	Read: Patient Safety in Biomedical Laboratories.
	Data Management and Documentation: Best practices in managing data from biomedical instruments, including documentation, electronic health records (EHR), and compliance.	Assignment: Create a data management plan for a biomedical laboratory.
Week 12	**Integration of Multiple Biomedical Instruments**: How different biomedical instruments work together in diagnostic and treatment workflows.	Read: Integration of Biomedical Instruments in Healthcare.
	Quality Control in Biomedical Instruments: Overview of quality assurance methods and tools used in maintaining biomedical equipment performance.	Assignment: Report on a quality control system for a biomedical device.
Week 13	**Biomedical Instrumentation in Clinical Research**: Role of instruments in clinical trials and laboratory research, with case studies from clinical settings.	Read: Biomedical Instruments in Research.
	Advanced Biomedical Instrumentation Technologies: Review of cutting-edge technologies like advanced imaging systems, robotic surgery tools, and AI in medical devices.	Assignment: Discuss the potential of AI in the future of biomedical instrumentation.

Week 14	**Wearable Health Devices**: Introduction to wearable health technologies such as smartwatches and fitness trackers, their uses, and limitations in healthcare.	Read: Wearable Biomedical Devices and Healthcare.
	Biomedical Instrumentation for Environmental Health: Instruments used to monitor environmental factors (e.g., air quality, temperature) and their impact on public health.	Assignment: Write a report on environmental health monitoring devices.
Week 15	**Biomedical Instrumentation in Point-of-Care Diagnostics**: Use of portable devices and biosensors in point-of-care diagnostics.	Read: Point-of-Care Diagnostics and Instruments.
	The Future of Biomedical Instrumentation: Emerging trends in digital health, telemedicine, and innovations in biomedical devices.	Assignment: Research and present on the future directions of biomedical instrumentation.
Week 16	**Review of Key Concepts**: Recap of major topics including instrumentation principles, regulatory standards, and the impact of technology on healthcare.	Review: Study and discuss key concepts for the final exam.
	Final Exam Week: Comprehensive final exam covering all topics from the course.	Final Exam: Complete written examination based on the course content.
Course Content (Lab)		**Assignments/Readings**
Week 1	**Introduction to Biomedical Instruments**: Familiarization with basic laboratory equipment (microscopes, spectrophotometers, etc.).	Assignment: Identify and describe the main components of common biomedical instruments.
Week 2	**Microscopy Techniques**: Hands-on practice with light and fluorescence microscopy, focusing on sample preparation and observation.	Read: Chapter on microscopy techniques and applications.
Week 3	**Spectrophotometer Operation**: Practical session on setting up and calibrating a spectrophotometer for absorbance and transmittance measurements.	Assignment: Report on the calibration process and its impact on measurement accuracy.
Week 4	**Centrifuge Operation**: Introduction to centrifugation techniques for sample separation. Hands-on with different types of centrifuges.	Lab Report: Observe the effects of varying speeds on sample separation.
Week 5	**Gel Electrophoresis**: Preparation of gels, sample loading, and running of electrophoresis for DNA or protein separation.	Assignment: Record and analyze gel electrophoresis results.
Week 6	**Calibration of Biomedical Instruments**: Practical session on the calibration of devices like ECG or EEG machines.	Read: Calibration methods and the importance of instrument accuracy.
Week 7	**Real-Time PCR Setup**: Hands-on practice with the real-time PCR system, including preparation of reagents and loading of samples.	Assignment: Discuss the principles of PCR and its biomedical applications.
Week 8	**Flow Cytometry**: Introduction to flow cytometry, learning about sample preparation, calibration, and data interpretation.	Read: Flow Cytometry in Diagnostics.
Week 9	**Mass Spectrometry**: Practical exposure to mass spectrometry, sample preparation, and data acquisition.	Assignment: Analyze mass spectrometry data from a biomedical perspective.
Week 10	**Chromatography Techniques**: Hands-on experience with chromatography (e.g., HPLC), sample preparation, and separation.	Lab Report: Analyze the separation results and discuss the efficiency of the technique.
Week 11	**ECG and EEG Recording**: Practical session on using ECG and EEG machines for recording physiological signals.	Assignment: Interpret sample ECG/EEG data from the session.
Week 12	**Defibrillator Operation**: Familiarization with	Read: Review of the defibrillator

	defibrillators and their use in emergency situations.	operation and safety protocols.
Week 13	**Patient Monitoring Systems**: Hands-on with pulse oximeters, blood pressure monitors, and temperature sensors.	Assignment: Report on the proper use and calibration of monitoring devices.
Week 14	**Biomedical Instrument Troubleshooting**: Practical troubleshooting of common issues in biomedical instruments like ECG, EEG, and spectrophotometers.	Assignment: Identify and troubleshoot common instrument malfunctions.
Week 15	**Data Management and Documentation**: Practical session on documenting experimental data and generating reports for lab experiments.	Assignment: Create a mock data management plan for a biomedical lab setting.
Week 16	**Final Practical Evaluation**: Comprehensive practical exam covering all instruments and techniques learned throughout the course.	Final Exam: Demonstrate proficiency with all instruments and techniques used in the course.

Textbooks and Reading Material

- Medical Instrumentation: Application and Design by Leslie Cromwell, Floyd J. Weibell, and Erich A. Pfeiffer:
- Handbook of Biomedical Instrumentation by Richard S. C. Cobbold:
- Biomedical Signal Processing by Rangaraj M. Rangayyan:

Teaching Learning Strategies

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Assignments: Types and Number with Calendar

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3. Presentation
4. Professional Writing Assignments

Assessment

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3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-305	Credit Hours	3 (3+0)
Course Title	Biosafety & Risk Management				

Course Introduction

Biosafety & Risk Management introduces the science of safety in healthcare, focusing on patient safety, risk management, and medical malpractice. The course emphasizes medical equipment safety, quality assurance, and regulatory strategies. Students will learn ISO/IEC standards and regulatory requirements crucial for translating medical device concepts into commercial products.

Learning Outcomes

On the completion of the course, the students will:

- **Assess Patient Safety Risks**: Identify, evaluate, and manage safety risks within healthcare environments, ensuring patient safety.
- **Implement Risk Management Strategies**: Develop and apply effective risk management plans to prevent adverse events and minimize medical malpractice.
- **Ensure Medical Equipment Safety**: Demonstrate knowledge of quality assurance testing and protocols to ensure the safety and reliability of medical devices.
- **Navigate Regulatory Requirements**: Understand and apply key ISO/IEC standards and regulatory frameworks governing medical device development and commercialization.
- **Contribute to Quality Management**: Contribute to the development and implementation of quality management systems in healthcare settings.
- **Promote Safety through Teamwork**: Collaborate effectively within multidisciplinary teams to improve safety outcomes and address healthcare risks.
- **Translate Concepts to Commercial Products**: Gain the skills needed to bring a medical device idea to market, ensuring it meets regulatory and safety standards.

Course Content (Theory)		Assignments/Readings
Week 1	**Introduction to the Science of Safety**: Basic principles of safety in biomedical instrumentation and healthcare.	Read: Importance of Safety in Healthcare.
	Errors and Adverse Events in Healthcare: Types of errors, their causes, and consequences in clinical settings.	Assignment: Case study on a healthcare-related adverse event.
	Models of Safety and Change: Different models for improving safety, including systems theory and the culture of safety.	Read: Models of Safety in Healthcare.
Week 2	**Culture of Safety**: Establishing a culture of safety within healthcare institutions.	Assignment: Research paper on creating a culture of safety in a healthcare facility.
	Detection and Reporting of Injuries and Errors: Methods for identifying and reporting clinical errors and injuries.	Assignment: Report on injury detection and reporting methods in hospitals.
	Investigative Methods: Techniques and methods for investigating adverse events and medical errors.	Read: Investigative Approaches to Safety.
Week 3	**Disclosure of Adverse Events**: Legal and ethical considerations in disclosing errors to patients.	Assignment: Discuss ethical guidelines for reporting adverse events.
	Improvement of Clinical Systems: Strategies for improving safety within clinical systems and reducing risk.	Assignment: Develop a proposal for improving a clinical system's safety measures.
	Policy Interventions: Role of policy in improving patient safety and reducing errors.	Read: The Role of Policy in Healthcare Safety.
Week 4	**Medical Device Safety and Risk Management**: Principles of medical device safety, risk assessment, and	Assignment: Research paper on risk management strategies for medical

	management.	devices.
	Effectiveness/Performance of Medical Devices: Assessing the effectiveness and performance of medical devices.	Assignment: Case study on the performance evaluation of a medical device.
	Phases in the Life Span of a Medical Device: Stages from development to decommissioning.	Read: Medical Device Life Cycle.
Week 5	**Participants in Ensuring Medical Device Safety**: Roles of manufacturers, regulators, clinicians, and patients in ensuring safety.	Assignment: Identify the key stakeholders in medical device safety.
	The Role of Each Participant/Stakeholder: Detailed roles and responsibilities of each participant in the safety process.	Read: Stakeholders in Medical Device Safety.
	Shared Responsibility for Device Safety and Performance: Collaborative efforts needed to ensure safety and performance.	Assignment: Discuss how shared responsibility improves medical device safety.
Week 6	**Regulatory Affairs Overview**: Introduction to regulatory frameworks for medical devices, including FDA and international regulations.	Read: Regulatory Affairs in Medical Device Development.
	Medical Device Classification (US - FDA): Understanding FDA classifications and regulations for medical devices.	Assignment: Research the FDA classification for a specific medical device.
	Medical Device Classification (Canada - MDELCE): Overview of Canada's MDELCE classification and approval processes.	Assignment: Compare FDA and Canadian device classification systems.
Week 7	**Medical Device Classification (EU - MDR)**: Understanding the EU MDR (Medical Device Regulation) and its impact on device approval.	Read: EU Regulations on Medical Devices.
	Marking Requirements for Medical Devices: Overview of labeling and CE marking requirements in the EU.	Assignment: Discuss marking and labeling requirements for devices.
	Quality Assurance Overview: Introduction to quality assurance principles and consensus standards.	Read: Quality Assurance in Biomedical Devices.
Week 8	**Overview of Recognized Consensus Standards**: Focus on ISO, IEC, and other quality standards in medical devices.	Assignment: Identify the most important consensus standards for a specific device.
	Quality Management Systems (QMS): Basics of QMS and their role in ensuring device quality throughout its lifecycle.	Assignment: Prepare a report on the importance of QMS in medical device manufacturing.
	FDA Quality System Regulations: Detailed discussion on FDA's QSR, including design controls, production, and testing.	Read: FDA Regulations and Quality Systems.
Week 9	**FDA Labeling Requirements**: Overview of FDA's labeling regulations and their role in device safety.	Assignment: Analyze the labeling requirements for a medical device.
	Process Validation in Medical Devices: Validation processes to ensure device performance and safety before commercialization.	Read: Process Validation in Device Manufacturing.
	Corrective and Preventive Actions (CAPA): Understanding CAPA systems and their role in addressing non-conformities.	Assignment: Case study on the application of CAPA in medical device companies.
Week 10	**Design Control in Medical Devices**: Introduction to design control processes to ensure safety and compliance.	Read: Design Control in Device Development.
	Risk Management and Mitigation Strategies: Exploring strategies for mitigating risk throughout a device's	Assignment: Create a risk management plan for a medical

	lifecycle.	device.
	Clinical Evaluation and Post-market Surveillance: Methods for assessing the clinical performance and monitoring devices post-market.	Read: Clinical Evaluation and Post-market Surveillance.
Week 11	**Clinical Trials and FDA Approval Process**: Overview of clinical trials and the FDA approval process for medical devices.	Assignment: Analyze the clinical trial requirements for FDA approval.
	Device Recalls and Handling Safety Issues: Procedures for handling device recalls and ensuring patient safety.	Assignment: Report on a recent device recall and its impact on public health.
	International Regulations and Harmonization: Exploring international regulations and efforts to harmonize medical device standards globally.	Read: International Medical Device Regulations.
Week 12	**Quality Systems and Compliance Audits**: The role of compliance audits in ensuring ongoing safety and quality of medical devices.	Assignment: Discuss the role of audits in maintaining device quality.
	Medical Device Risk Assessment and Mitigation: Approaches to evaluating and mitigating risks during the device lifecycle.	Read: Risk Assessment in Medical Devices.
	Regulatory Submissions and Documentation: How to prepare regulatory submissions and meet documentation requirements for device approval.	Assignment: Prepare a mock regulatory submission.
Week 13	**Medical Device Innovation and Regulatory Considerations**: Understanding how innovation affects regulatory approvals.	Read: Regulatory Considerations in Device Innovation.
	Market Entry Strategies for Medical Devices: Strategies for entering the market with a new medical device, considering regulatory and quality requirements.	Assignment: Create a market entry strategy for a new medical device.
	Ethical Considerations in Device Safety and Regulation: Addressing ethical challenges in the safety, regulation, and commercialization of medical devices.	Read: Ethics in Medical Device Safety and Regulation.
Week 14	**Post-market Surveillance and Device Safety**: Methods of ensuring device safety and performance after market introduction.	Assignment: Research on post-market surveillance systems for medical devices.
	Medical Device Safety in Emerging Markets: Challenges and strategies for ensuring device safety in developing regions.	Read: Global Safety Challenges for Medical Devices.
	Final Review of Medical Device Safety and Regulations: Recap of key regulatory and safety topics in biomedical instrumentation.	Review: Study for final exam on device safety and regulation.
Week 15	**Case Studies in Medical Device Failures**: Review of case studies involving medical device failures and their impact.	Assignment: Analyze a case study of a medical device failure.
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	Case Studies in Medical Device Failures: Review of case studies involving medical device failures and their impact.	Assignment: Analyze a case study of a medical device failure.
Week 16	**Final Exam Preparation**: Comprehensive review and preparation for the final exam.	Review: Comprehensive review session.
	Final Exam Preparation: Comprehensive review and preparation for the final exam.	Review: Comprehensive review session.
	Final Exam: Written examination on all topics covered in the course.	Final Exam: Assessment of theoretical knowledge on device

		safety and regulations.

Textbooks and Reading Material

- Rene, E. R., Shu, L., &Jegatheesan, V. (2019). *Environmentally Friendly (Bio)Technologies for the Removal of Emerging Organic and Inorganic Pollutants from Water.* IWA Publishing.
- Jain, A., Agarwal, J., & Venkatesh, V. (2018). *Microbiology Practical Manual* (E-book). Elsevier Health Sciences.
- Stawicki, S. P., Firstenberg, M. S., Galwankar, S. C., Izurieta, R., &Papadimos, T. (2021). *Contemporary Developments and Perspectives in International Health Security: Volume 1.*BoD – Books on Demand.
- Wang, B. (2022). *Medical Equipment Maintenance: Management and Oversight.* Springer Nature.
- Salerno, R. M., &Gaudioso, J. M. (2021). *Laboratory Bio Risk Management: Biosafety and Biosecurity.* CRC Press.
- Biram, T. (2019). *Biotech & Bioethics.* Issues Series.
- Great Britain: Department of Health: Estates and Facilities Division. (2018). *Safe Management of Healthcare Waste: Environment and Sustainability.* The Stationery Office.

Teaching Learning Strategies

1. **Interactive Lectures**
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2. **Collaborative Learning**
   Students will work in pairs or small groups to write essays, analyze readings, and give peer feedback on presentations.
3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-306	Credit Hours	3 (0+3)
Course Title	Clinical Lab Practices				

Course Introduction

Clinical Laboratory Practices is a fundamental course designed to introduce allied health sciences undergraduate students to the core principles and techniques employed in clinical laboratories. This course provides a solid foundation in essential laboratory procedures, safety protocols, and quality assurance practices.

By the end of this course, students will develop the necessary skills to work effectively in a clinical laboratory setting. They will gain hands-on experience in performing various laboratory tests, interpreting results, and applying critical thinking to diagnose and manage diseases.

Learning Outcomes

On the completion of the course, the students will:

- Understand basic laboratory principles, techniques, and equipment.
- Adhere to laboratory safety regulations and emergency procedures.
- Perform various clinical laboratory tests accurately.
- Analyze and interpret laboratory results effectively.
- Implement quality assurance measures to ensure reliable results.

Course Content (Theory)		Assignments/Readings
Week 1	**Preparation of Normal Solution**: Prepare normal, buffer, percent, and molar solutions.	Assignment: Document the steps for preparing each solution.
	Preparation of Normal Saline: Prepare 0.9% normal saline solution for laboratory use.	Read: Chapter on solution preparation and its role in lab tests.
	Methods of Measuring Liquids: Learn how to measure liquids accurately using pipettes, burettes, and graduated cylinders.	Assignment: Perform liquid measurement with pipettes and record measurements.
Week 2	**Weighing Solids**: Practice using balances to weigh solids accurately for experiments.	Assignment: Weigh several solid substances and record results.
	Calibration of Equipment: Learn how to calibrate balances, pipettes, and spectrophotometers.	Assignment: Calibrate a balance and a pipette; document the process.
	Introduction to Chemical Pathology: Overview of basic chemical pathology concepts and laboratory terminology.	Read: Chapter on chemical pathology terminology and its application in the lab.
Week 3	**Patient Preparation**: Learn how to prepare patients for various sample collections (urine, blood, sputum).	Assignment: Describe the preparation steps for blood collection.
	Sample Collection (Urine, Blood, Sputum): Collect and label urine, blood, and sputum samples according to lab protocols.	Assignment: Collect and properly label urine and blood samples.
	Sample Processing & Handling: Practice the correct methods of processing and storing urine, blood, and sputum samples.	Assignment: Discuss how sample handling affects the test outcomes.
Week 4	**Different Methods of Blood Collection**: Perform venipuncture, capillary, and arterial blood collection.	Assignment: Record blood collection techniques and complications.
	Preparation of Anticoagulant Bottles: Learn how to prepare anticoagulant bottles for blood collection.	Assignment: Prepare anticoagulant bottles and label correctly.
	Sample Transport and Storage: Study how to properly transport and store clinical samples for testing.	Assignment: Demonstrate how to transport blood and urine samples.

Week 5	**Isolation of Nucleic Acids**: Extract DNA or RNA from a given sample and determine its concentration using a spectrophotometer.	Assignment: Extract nucleic acid and calculate concentration.
	Determination of Nucleic Acid Purity: Analyze the purity of extracted nucleic acids using spectrophotometry (A260/A280 ratio).	Assignment: Assess nucleic acid purity and interpret results.
	Preparation of DNA/RNA Samples: Prepare DNA or RNA samples for further analysis (e.g., PCR).	Assignment: Prepare DNA sample for PCR testing.
Week 6	**Biochemical Tests for Bacterial Identification**: Perform tests like casein hydrolysis, catalase, and citrate utilization to identify bacteria.	Assignment: Record and interpret biochemical test results.
	Coagulase Test: Perform the coagulase test to differentiate Staphylococcus species.	Assignment: Prepare a report on coagulase test results.
	Indole and Nitrate Reduction Test: Test for indole production and nitrate reduction in bacteria.	Assignment: Document the results of indole and nitrate reduction tests.
Week 7	**Hydrogen Sulfide Production Test**: Perform the hydrogen sulfide (H2S) production test for bacterial identification.	Assignment: Interpret results of H2S production in bacteria.
	Oxidase Test: Perform the oxidase test to identify oxidase-positive bacteria.	Assignment: Record observations for oxidase test.
	Urease Test: Conduct urease testing to identify bacteria that hydrolyze urea.	Assignment: Prepare a report on urease test outcomes.
Week 8	**Urinalysis – Collection and Preservation**: Techniques for urine collection and its preservation for laboratory analysis.	Assignment: Collect urine sample and preserve for later analysis.
	Physical Examination of Urine: Perform visual inspection for color, clarity, specific gravity, and pH.	Assignment: Record the physical characteristics of urine samples.
	Microscopic Examination of Urine: Prepare and examine urine sediment to identify cells, crystals, and casts.	Assignment: Prepare urine slides and document microscopic findings.
Week 9	**Chemical Examination of Urine**: Test for substances like glucose, ketones, proteins, and nitrites in urine.	Assignment: Perform chemical tests and interpret results.
	24-Hour Urine Collection for Protein: Collect and process a 24-hour urine sample for protein analysis.	Assignment: Analyze protein levels in a 24-hour urine collection.
	Urine Sediment Preparation: Prepare urine sediment for microscopic examination and identification of formed elements.	Assignment: Prepare and examine urine sediment under the microscope.
Week 10	**Pregnancy Testing Methods**: Perform pregnancy tests using urine samples, including hCG assays.	Assignment: Perform a pregnancy test using a urine sample.
	Chronic Gonadotropin Assay: Learn how to measure hCG levels in urine as part of a pregnancy test.	Assignment: Interpret results of a hCG urine assay.
	Other Pregnancy Tests: Explore alternative methods for detecting pregnancy using urine samples.	Assignment: Discuss different types of pregnancy test methods.
Week 11	**Casein Hydrolysis Test for Bacteria**: Perform a casein hydrolysis test and interpret results for bacterial identification.	Assignment: Record and interpret the casein hydrolysis test.
	Catalase Test: Perform a catalase test to identify catalase-positive organisms.	Assignment: Document results of the catalase test and discuss its significance.
	Citrate Utilization Test: Conduct a citrate utilization test to identify bacteria that can use citrate as a carbon source.	Assignment: Record observations and discuss the outcomes of the test.
Week 12	**Bacterial Identification Using Biochemical Tests**: Combine results from multiple biochemical tests to identify bacterial species.	Assignment: Identify a bacterial species based on biochemical test results.

	Urine Specific Gravity and pH Testing: Learn how to measure and interpret urine specific gravity and pH.	Assignment: Measure specific gravity and pH of urine samples.
	Urine Culture and Microscopic Examination: Perform urine culture and examine microscopic urine sediment.	Assignment: Record findings of a urine culture and sediment examination.
Week 13	**Microscopic Examination of Sputum Samples**: Prepare and examine sputum samples for microbial presence.	Assignment: Prepare sputum slides and interpret results under the microscope.
	Bacterial Culture from Sputum Samples: Perform bacterial culture from sputum samples to isolate pathogens.	Assignment: Record bacterial growth from sputum culture.
	Sensitivity Testing: Perform antimicrobial sensitivity testing on bacterial isolates.	Assignment: Interpret the results of an antimicrobial sensitivity test.
Week 14	**Bacterial Growth on Selective Media**: Grow bacteria on selective media to identify specific pathogens.	Assignment: Record bacterial growth on different media types.
	Gram Staining of Bacterial Samples: Perform Gram staining to differentiate between Gram-positive and Gram-negative bacteria.	Assignment: Prepare a report on Gram stain results.
	Gram-Positive and Gram-Negative Bacteria Identification: Identify Gram-positive and Gram-negative bacteria using biochemical tests.	Assignment: Identify bacteria based on Gram stain and biochemical tests.
Week 15	**Preparation of Reagents for Biochemical Tests**: Prepare reagents needed for various biochemical tests like catalase, oxidase, and coagulase.	Assignment: Prepare the necessary reagents and document the preparation process.
	Identification of Microorganisms by Biochemical Methods: Practice identifying microorganisms using a series of biochemical tests.	Assignment: Identify microorganisms based on the biochemical tests performed.
	Clinical Significance of Urinalysis: Discuss the clinical importance of various urinalysis tests in diagnosing diseases.	Assignment: Write a report on the clinical significance of urine tests.
Week 16	**Blood Collection Techniques Review**: Recap the various blood collection methods (venipuncture, capillary, and arterial).	Assignment: Demonstrate proper blood collection techniques.
	Final Examination of Microscopic and Biochemical Techniques: Final assessment of students' proficiency in microscopy and biochemical tests.	Assignment: Prepare a report on your final practical exam results.
	Conclusion and Review: Review all the practical techniques and discuss key learning outcomes from the course.	Assignment: Submit a final report on clinical lab practices learned during the course.

Textbooks and Reading Material

- Cheesbrough M. District laboratory practice in tropical countries. Cambridge university press; 2006, Part I & II.
- Lieseke CL, Zeibig, EA. Essentials of Medical Laboratory Practice. F.A. Davis Company, Philadelphia, 2012
- Crocker J, Burnett D, The Science of laboratory diagnosis. John Wiley & Sons; 2005. Ridley J. Essentials of Clinical Laboratory Science. Delmar Cengage Learning; 2010

Teaching Learning Strategies

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   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
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   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
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Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
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3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-307	Credit Hours	3 (3+0)
Course Title	Epidemiology				

Course Introduction

Epidemiology is the cornerstone of public health, focusing on the study of how diseases affect the health and illness of populations. It is essential for understanding the distribution and determinants of health-related events, which is crucial for designing effective health programs and policies. This course provides undergraduate students in Allied Health Sciences with foundational knowledge and practical skills necessary to analyze health data, assess public health needs, and implement evidence-based interventions.

Learning Outcomes

On the completion of the course, the students will:

- Define Epidemiology: Understand its significance and basic concepts related to population health.
- Identify Study Designs: Recognize and differentiate among various epidemiological study designs (descriptive, analytical, and experimental).
- Analyze Outcomes: Calculate and interpret epidemiological measures such as incidence rates, prevalence, relative risk, and odds ratios.
- Evaluate Causality: Distinguish between correlation and causation, assessing factors contributing to disease occurrence.
- Communicate Findings: Effectively convey epidemiological data and health implications to diverse audiences.

	Course Content (Theory)	Assignments/Readings
Week 1	Introduction to Epidemiology: Definition and Importance	
	Types of Study Designs: Overview	Read: Articles on study design types
	Descriptive Studies: Case Reports and Case Series	Prepare a case report
Week 2	Cross-Sectional Studies: Prevalence Measures	Analyze a cross-sectional study
	Cohort Studies: Incidence and Relative Risk	Read: Cohort study examples
	Case-Control Studies: Odds Ratio	Prepare a report on a case-control study
Week 3	Experimental Studies: Clinical Trials and Interventions	Read: Clinical trial methodologies
	Outcome Measures: Relative Risk, Odds Ratio	Discuss outcome measures in class
	Causality vs. Association: Key Concepts	Read: Causality articles
Week 4	Inferential Epidemiology: Statistics in Public Health	Complete statistical assignments
	Validity and Reliability in Epidemiological Research	Read: Validity and reliability studies
	Measuring Disease Burden: Rates and Ratios	Analyze population data
Week 5	Incidence vs. Prevalence: Definitions and Differences	Prepare a comparison chart
	Role of Chance, Confounding, and Bias in Interpretations	Case study analysis
	Screening in Disease Control: Importance and Methods	Review screening programs
Week 6	Community Diagnosis: Strategies for Assessing Epidemiological Issues	Conduct a community health assessment
	Study Design Strengths and Limitations: A Comparative Analysis	Group project on study designs
	Descriptive Studies Practices: Applying Knowledge	Present findings from case series

		analysis
Week 7	Analytical Studies Practices: Case-Control and Cohort	Compare findings from different study types
	Community Health Strategies: Implementation and Evaluation	Write a proposal for a community health project
	Review of Epidemiological Concepts	Mid-term examination preparation
Week 8	Data Analysis Techniques in Epidemiology	Complete data analysis exercises
	Ethical Considerations in Epidemiological Research	Read: Ethics in epidemiology
	Health Surveillance Systems: Importance and Functionality	Research local health surveillance systems
Week 9	Public Health Interventions: Success Stories and Lessons Learned	Prepare a case study analysis
	Ongoing Research and Future Directions in Epidemiology	Review current epidemiological studies
	Epidemiology of Infectious Diseases	Read: Infectious disease epidemiology
Week 10	Epidemiology of Non-communicable Diseases	Write an essay on a non-communicable disease
	Biostatistics in Epidemiology: Applications	Complete biostatistics exercises
	Review: Key Concepts in Epidemiology	Group discussion and Q&A
Week 11	Advanced Topics in Epidemiology: Genetic and Environmental Factors	Read recent research articles
	Practical Applications of Epidemiology in Allied Health	Case study presentations
	Guest Lecture: Real-World Applications of Epidemiology	Prepare questions for the guest lecturer
Week 12	Problem-Based Learning in Epidemiological Contexts	Participate in PBL sessions
	Epidemiological Data Interpretation	Analyze provided datasets
	Surveillance and Outbreak Investigation	Conduct an outbreak investigation simulation
Week 13	Communicating Epidemiological Findings	Prepare a presentation on findings
	Revision: Study Design and Methods	Review all study designs
	Review: Measuring Disease Burden	Prepare a summary report
Week 14	Case Studies in Epidemiology	Discuss case studies in groups
	Final Exam Preparation	Study groups and review sessions
	Final Examination	Refer to materials covered
Week 15	Course Feedback and Reflection	Submit feedback forms
	Applications in Public Health Practice	Prepare a public health policy proposal
	Special Topics: Emerging Issues in Epidemiology	Research and present on an emerging issue
Week 16	Career Opportunities in Epidemiology	Guest speaker on career paths
	Future Trends and Innovations in Epidemiology	Discuss potential future advancements

	Course Conclusion and Summary	Submit final portfolios

Textbooks and Reading Material

- Beaglehole R, Bonita R, Kjellstrom T. Basic epidemiology. Geneva: World Health Organization; 1993.
- Gordis L. Epidemiology. Philadelphia, PA: WB Saunders Company; 2008.
- Greenberg RS, Daniels SR, Flanders WD, Eley JW, Boring JR. Medical Epidemiology, 2nd ed. New York, NY: McGraw Hill; 1996.
- Hennekens CH, Buring JE. Epidemiology in medicine. Boston, MA: Little Brown and Company; 1987.
- Holford TR. Multivariate methods in epidemiology. New York, NY: Oxford University Press; 2002.

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3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-308	Credit Hours	3(2+1)
Course Title	Cytopathology & Endocrinology				

Course Introduction

In Cytopathology, students will learn the principles, techniques, and applications involved in analyzing cellular specimens to diagnose diseases, including cancer. Through hands-on laboratory exercises and theoretical sessions, they will develop skills in specimen collection, preparation, staining, and microscopic examination, with a strong emphasis on accurate diagnosis and effective communication of findings to facilitate appropriate patient management.

The Endocrinology component delves into the intricate workings of the endocrine system, focusing on hormonal regulation and its significant impact on human health. Students will explore the physiological processes controlled by hormones and their role in maintaining homeostasis. This portion of the course combines theoretical instruction, laboratory investigations, and case studies, enabling participants to understand the complex interplay between hormones, their target organs, and the clinical manifestations of various endocrine disorders.

Together, these disciplines provide a holistic approach to understanding disease processes and the vital role of accurate diagnosis and hormonal regulation in patient care.

Learning Outcomes

On the completion of the course, the students will:

- Cytopathology Focus: Understand principles and techniques for analyzing cellular specimens.
- Hands-On Experience: Gain practical skills in specimen collection, preparation, and staining.
- Accurate Diagnosis: Emphasize the importance of precise diagnoses for effective patient management.
- Endocrinology Exploration: Study hormonal regulation and its critical role in maintaining health.
- Physiological Processes: Learn the interactions between hormones and their impact on various endocrine disorders.

Course Content (Theory)		Assignments/Readings
Week 1	Introduction to Cytopathology: Definition and scope	Read introductory material on Cytopathology principles
	Historical perspective and evolution of cytopathology	Review the timeline of key developments in Cytopathology
Week 2	Comparison of cytology and histopathology	Compare and contrast cases from both fields
	Cellular morphology: Components and organelles	Study normal cellular structures via diagrams
Week 3	Normal cellular morphology across different body systems	Read chapters on cellular types and functions
	Specimen collection techniques: FNA and exfoliative cytology	Practice specimen collection methods in lab
Week 4	Preparation of cytological slides and fixation methods	Prepare slides and apply fixation techniques
	Cytological staining techniques: Romanowsky stains	Perform staining exercises with Giemsa and Pap stain
Week 5	Interpretation of cytological findings: Recognition of cells	Analyze case studies for normal and abnormal cells
	Diagnostic criteria for benign, atypical, and malignant cells	Discuss criteria and differential diagnosis
Week 6	Gynecologic cytopathology: Pap smear screening and interpretation	Critique Pap smear examples and grading systems
	HPV testing and cervical intraepithelial neoplasia (CIN)	Study CIN grading and its clinical relevance

Week 7	Non-gynecologic cytopathology: Respiratory and urine cytology	Review examples of cytology from various fluids
	Ancillary techniques: Immunocytochemistry and molecular diagnostics	Explore ancillary techniques through literature
Week 8	Challenges and limitations: False interpretations and quality assurance	Evaluate case studies highlighting diagnostic challenges
	Emerging trends in cytopathology: Digital cytology and liquid-based techniques	Research and present on a recent technological advancement
Week 9	Introduction to Endocrinology: Importance and scope	Read introductory materials on the field of Endocrinology
	Overview of endocrine glands: Locations and structures	Identify major endocrine glands in anatomical diagrams
Week 10	Functional anatomy of different endocrine glands	Study the structural role of each gland
	Chemical nature and biosynthesis of hormones	Review biochemical pathways involved in hormone synthesis
Week 11	Transport mechanisms of hormones to sites of action	Analyze how hormones are distributed in the body
	Mechanism of hormone action: Hormonal signaling overview	Discuss basic concepts of hormonal signaling
Week 12	Types of cell signaling and transduction pathways	Compare different signaling mechanisms in detail
	Physiological actions of hypothalamic hormones	Examine specific functions of hypothalamic hormones
Week 13	Hormones of the pituitary gland: Functions and regulation	Review hormonal secretions of the pituitary and their effects
	Thyroid and parathyroid hormones: Functions and metabolic roles	Study hormone functions of thyroid and parathyroid glands
Week 14	Endocrine pancreas: Insulin and glucagon roles	Discuss the regulation of glucose metabolism by these hormones
	Functions of adrenal cortex and adrenal medulla hormones	Explore the physiological impacts of adrenal hormones
Week 15	Hormones of gonads and the role of pineal and thymus	Review reproductive hormones and immune functions of thymus
	Endocrine secretions of heart, kidney, and adipose tissue	Analyze the roles of hormones from these unique tissues
Week 16	Control of hormonal secretion: Feedback mechanisms	Discuss negative and positive feedback loops in hormone regulation
	Integration of endocrine functions and case studies	Review clinical case studies related to hormonal disorders
Course Content (Lab)		**Assignments/Readings**
Week 1	Specimen collection and preparation: Aseptic techniques	Review protocols for fine needle aspiration and exfoliative cytology
Week 2	Preparing cytological slides: Fixation methods	Practice slide preparation using different fixation techniques
Week 3	Cytopreparatory techniques: Centrifugation and filtration	Conduct centrifugation and filtration on collected specimens
Week 4	Cytological staining techniques: Romanowsky stains	Perform Giemsa and Wright-Giemsa stains on prepared slides
Week 5	Applying the Papanicolaou stain for gynecological specimens	Stain gynecological specimens and evaluate staining quality

Week 6	Microscopic examination: Identifying normal cellular morphology	Examine stained slides under a light microscope for normal cells
Week 7	Gynecologic cytopathology: Screening and interpreting Pap smears	Screen and classify Pap smears, grading CIN lesions
Week 8	Non-gynecologic cytopathology: Analyzing various specimens	Analyze respiratory, urine, and CSF specimens for abnormalities
Week 9	Demonstration of the position of various endocrine glands	Review anatomy of endocrine glands and their physiological functions
Week 10	Examining the effect of insulin on glycaemic levels	Conduct experiments to measure blood glucose response to insulin
Week 11	Determining random and fasting blood glucose levels	Perform blood glucose testing and analyze results
Week 12	Performing the oral glucose tolerance test (OGTT)	Administer OGTT and interpret the outcomes
Week 13	Assessing the effect of cortisol on biochemical parameters	Analyze changes in glucose and protein levels after cortisol administration
Week 14	Investigating the effect of melanocyte-stimulating hormone (MSH) on skin pigmentation	Observe and record pigmentation changes in response to MSH
Week 15	Case study analysis of endocrine dysfunctions	Review and discuss case studies related to hormone imbalances
Week 16	Summary of practical findings and clinical correlations	Prepare a report summarizing experiments and their implications in endocrine health

Textbooks and Reading Material

- Koss, L. G., & Melamed, M. R. (Eds.). (2020). Koss's Cytology of the Urinary Tract with Histopathologic Correlations. LWW.
- Cibas, E. S., & Ducatman, B. S. (2020). Cytology: Diagnostic Principles and Clinical Correlates. Elsevier.
- Mills, S. E. (Ed.). (2019). Sternberg's Diagnostic Surgical Pathology. LWW.
- Geller, S. A., & Mody, D. R. (Eds.). (2018). Cytopathology of Infectious Diseases. Elsevier.
- Voet, D., Voet, D. J., & Voet, J. G. (2021). Biochemistry. John Wiley & Sons.
- Wondisford, F. E. (2020). Essentials of Endocrinology and Metabolism: A Practical Guide for Medical Students. Springer Nature.
- Ulloa-Aguirre, A., & Tao, Y. (2021). Cellular Endocrinology in Health and Disease. Academic Press.

Teaching Learning Strategies

1. **Interactive Lectures**
   Engage students with interactive presentations, discussions, and real-time corrections of writing and speaking errors.
2. **Collaborative Learning**
   Students will work in pairs or small groups to write essays, analyze readings, and give peer feedback on presentations.
3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-309	Credit Hours	3(2+1)
Course Title	Research Methodology & Skill Enhancement				

Course Introduction

This course is designed to provide you with a comprehensive understanding of research methodologies and equip you with essential skills for conducting effective research. Whether you are starting your academic journey, preparing for advanced studies, or looking to enhance your professional capabilities, this course will serve as a foundational experience.

Learning Outcomes

On the completion of the course, the students will:

- **Understanding Research Principles**: Knowledge of qualitative, quantitative, and mixed-method research approaches.
- **Formulation of Research Questions**: Ability to generate relevant, clear, and testable research questions and hypotheses.
- **Literature Review & Critical Analysis**: Skill in conducting literature reviews and critically analyzing existing research.
- **Research Design & Method Selection**: Ability to choose appropriate research designs and methods based on objectives.
- **Data Collection Techniques**: Proficiency in qualitative and quantitative data collection methods (e.g., surveys, interviews, experiments).
- **Data Analysis & Interpretation**: Ability to analyze data using statistical tools or qualitative coding techniques.
- **Report Writing & Presentation**: Skill in writing structured research reports and presenting findings clearly.
- **Critical Thinking & Problem Solving**: Ability to evaluate research methodologies and solve problems creatively.
- **Ethical Considerations**: Understanding and applying ethical standards in research (e.g., informed consent, confidentiality).
- **Communication Skills Enhancement**: Improvement in both written and oral communication for presenting research effectively.
- **Use of Technology in Research**: Proficiency in using digital tools for data collection, analysis, and citation management.
- **Time Management & Project Planning**: Ability to plan and manage research projects within set timelines and resources.

Course Content (Theory)		Assignments/Readings
Week 1	Introduction to Research Methodology; Overview of unethical academic practices (plagiarism)	Read: Research Ethics
	Importance of research and need for research in various fields; Types of research	Read: Article on Types of Research Methods
Week 2	Extraction and review of literature; Importance of literature review in research	Assignment: Conduct a brief literature review on a chosen topic
	Understanding the process of reviewing literature; Tools for literature review	Read: Research papers on systematic review
Week 3	Identifying a research problem: Key strategies and methods	Assignment: Identify a research problem from current issues
	Formulating a research hypothesis and objectives	Read: Guidelines for hypothesis formulation
Week 4	Designing a study: Research designs and their application	Assignment: Choose a research design for a given problem
	Types of research designs: Experimental, non-	Read: Research Designs

	experimental, and observational	
Week 5	Data collection methods: Qualitative vs. Quantitative methods	Assignment: Prepare a data collection plan for a research project
	Ethical considerations in data collection	Read: Articles on ethical guidelines for data collection
Week 6	Data collection tools and techniques: Surveys, Interviews, Questionnaires	Assignment: Design a survey for data collection
	Introduction to data interpretation and analysis	Read: Data Analysis Techniques
Week 7	Statistical tools for data analysis; Quantitative vs. qualitative analysis	Assignment: Practice with SPSS or other statistical tools
	Introduction to qualitative data analysis and coding	Read: Articles on qualitative data analysis methods
Week 8	Analyzing research results and drawing conclusions	Assignment: Analyze a given dataset and write findings
	Writing a research report: Structure and components	Read: Guidelines for writing research papers
Week 9	Writing a thesis or research article: Common sections and formats	Assignment: Draft the introduction and literature review for a thesis
	Writing a research article or review: Submission guidelines for journals	Read: Sample research articles and review them
Week 10	Preparing research posters: Key elements and design tips	Assignment: Create a research poster based on a research topic
	Making scientific presentations: Effective delivery and communication	Assignment: Prepare a presentation for a research topic
Week 11	Creating impactful presentations: Visual aids and slides	Read: Effective Presentation Skills
	Intellectual property: Understanding copyrights, patents, and research ownership	Read: Articles on intellectual property in research
Week 12	Managing references and citations using tools like Zotero	Assignment: Set up a citation manager and add references
	Writing an abstract: Importance and guidelines	Assignment: Write an abstract for a research project
Week 13	Peer review process in research publishing	Read: Article on the peer review process in academic journals
	Ethical issues in publishing and authorship	Assignment: Analyze ethical dilemmas in academic publishing
Week 14	Advanced research tools and software	Read: advanced research tools and data analysis software
	Final project preparation: Structuring a research project	Assignment: Finalize research project proposal
Week 15	Presenting research findings effectively in conferences	Read: Case studies on successful conference presentations
	Preparing for a final exam or project submission	Review: Course material and guidelines for final submission
Week 16	Final research project presentation	Assignment: Present final research project to the class
	Review and evaluation of research projects; Feedback and improvements	Submit final project report; Peer review of projects
Course Content (Lab)		**Assignments/Readings**
Week 1	Introduction to practical research; Ethical guidelines in research and unethical practices (plagiarism)	Read: Article on ethical issues in research

Week 2	Identifying a research problem and formulating a hypothesis	Assignment: Select a research problem and formulate a hypothesis
Week 3	Literature extraction and review techniques; Using databases for literature review	Assignment: Extract key papers on a given topic
Week 4	Analyzing and summarizing literature; Developing a literature review framework	Assignment: Write a brief literature review
Week 5	Designing a study: Choosing research methods and tools	Read: Chapter on study designs and methodology
Week 6	Designing surveys and questionnaires for data collection	Assignment: Design a survey or questionnaire
Week 7	Ethical considerations during data collection; Informed consent and confidentiality	Read: Ethical guidelines for data collection
Week 8	Collecting data using surveys and interviews	Practical: Conduct a survey or interview session
Week 9	Data entry and organization; Using software for data entry	Assignment: Enter collected data into an Excel sheet or data software
Week 10	Introduction to data analysis: Descriptive statistics and basic interpretation	Practical: Perform basic data analysis using Excel or SPSS
Week 11	Qualitative data analysis: Coding and identifying themes	Assignment: Analyze qualitative data using NVivo or other tools
Week 12	Writing a research report: Structure and key sections	Assignment: Draft the introduction and methodology sections
Week 13	Preparing research posters: Design principles and layout	Practical: Design a research poster for a selected topic
Week 14	Making scientific presentations: Presentation techniques and visual aids	Practical: Prepare and present a research topic to the class
Week 15	Intellectual property: Understanding copyrights, patents, and research ownership	Read: Articles on intellectual property in research
Week 16	Final practical project: Preparing and presenting a research report	Assignment: Final presentation and submission of the research report

Textbooks and Reading Material

- Bryman A, 2001. Social research methods. 2nd Edition; Oxford University Press.
- Awan JA, 2003. Scientific Presentation. Unitech Communication, Faisalabad, Pakistan.
- Kumar R, Kindersley D, 2010. Research Methodology: A step by step guide for beginners. Third Edition; SAGE Publications.

Teaching Learning Strategies

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   To practice persuasive speaking, public speaking, and informal conversations.
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   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-310	Credit Hours	3(2+1)
Course Title	Bioinformatics				

Course Introduction

This course covers the collection, classification, storage, and analysis of biochemical and biological data using computational tools, with a particular focus on molecular genetics and genomics. It explores genetic transfer mechanisms in bacteria, genome organization, and various molecular biological techniques. The course also includes molecular diagnostic procedures and their applications. Additionally, students will learn to use specialized software and computational tools to manage and analyze molecular biology data.

Learning Outcomes

On the completion of the course, the students will:

- **Proficiency in Bioinformatics Tools**: Use computational tools to collect, analyze, and manage biochemical and biological data, particularly in molecular genetics and genomics.
- **Understanding Genetic Transfer Mechanisms**: Explain the genetic transfer mechanisms in bacteria and the organization of genomes.
- **Mastery of Molecular Biological Techniques**: Gain hands-on experience with key molecular biology techniques like PCR, gel electrophoresis, and gene sequencing.
- **Application of Molecular Diagnostics**: Apply molecular diagnostic procedures in clinical and research settings to detect diseases and analyze genetic information.
- **Data Integration and Analysis**: Integrate molecular biology data with bioinformatics software to draw meaningful conclusions and advance research.

	Course Content (Theory)	Assignments/Readings
Week 1	Introduction to Bioinformatics; Importance of Bioinformatics in modern research	Read: Role of Bioinformatics
	Glossary of important bioinformatics terms and concepts	Read: Glossary list; Define key terms
Week 2	Timeline of Bioinformatics development	Assignment: Research and create a timeline of bioinformatics milestones
	Biological Databases: Overview and significance	Read: Article on types of biological databases
Week 3	Data Annotation and Redundancy: Understanding data management	Assignment: Identify annotated data in a given database
	Sequence Storage: Principles and practices in sequence data storage	Read: data storage methods
Week 4	Sequence Retrieval and Analysis: Techniques and methods	Practical: Retrieve a sequence and perform basic analysis
	Similarity and Homology: Concepts in sequence comparison	Assignment: Compare sequences for similarity and homology
Week 5	Introduction to Entrez: A tool for sequence retrieval	Practical: Explore and retrieve sequences from Entrez
	Introduction to National Center for Biotechnology Information (NCBI)	Read: Overview of NCBI resources
Week 6	GENBANK Sequence Database: Accessing and understanding GENBANK data	Practical: Retrieve sequences from GENBANK
	European Bioinformatics Institute (EBI): Overview and tools	Assignment: Explore tools available at EBI
Week 7	DNA Data Bank of Japan (DDBJ): Features and usage	Read: Overview of DDBJ and its databases
	Different Tools Used in Bioinformatics: An introduction to	Practical: Familiarize with various

	bioinformatics tools	bioinformatics tools
Week 8	Reverse Complement: Understanding the concept and application	Practical: Perform reverse complement of a given sequence
	Creating Alignments: Introduction to sequence alignment	Assignment: Create a basic alignment of two sequences
Week 9	Local and Global Alignment: Differences and applications	Practical: Perform local and global alignments using software
	Pairwise Sequence Alignment: Techniques and methods	Practical: Perform pairwise sequence alignment using CLUSTALW
Week 10	Multiple Sequence Alignment: Understanding and techniques	Practical: Perform multiple sequence alignment
	Phylogenetic Analysis: Introduction and methods	Read: Article on phylogenetic tree construction
Week 11	OMEGA: Introduction to OMEGA tool for bioinformatics	Practical: Use OMEGA to analyze sequences
	CLUSTALW: Sequence alignment using CLUSTALW	Practical: Align multiple sequences using CLUSTALW
Week 12	ExPASy: Introduction to ExPASy tools and databases	Assignment: Explore and use ExPASy tools
	BLAST, BLAT, and FASTA: Sequence searching and comparison tools	Practical: Use BLAST to compare sequences
Week 13	PDB File Structure: Understanding Protein Data Bank files	Read: Overview of PDB file structure
	NEB CUTTER: Introduction to NEB CUTTER tool	Practical: Use NEB CUTTER for restriction enzyme analysis
Week 14	UNIPROT: Understanding and using UNIPROT database	Assignment: Search and explore data in UNIPROT
	SWISSPROT: Using the SWISSPROT database for protein analysis	Practical: Retrieve protein data from SWISSPROT
Week 15	BIOEDIT: Introduction to BIOEDIT for sequence analysis	Practical: Perform sequence editing using BIOEDIT
	MEGA 6: Introduction to MEGA 6 for phylogenetic analysis	Practical: Use MEGA 6 for phylogenetic tree construction
Week 16	Review of Bioinformatics Tools and Databases	Assignment: Prepare a report on the bioinformatics tools learned
	Final Project: Application of bioinformatics tools in a research project	Submit final project report and present findings
Course Content (Lab)		**Assignments/Readings**
Week 1	Introduction to NCBI: Overview and resources	Read: Introduction to NCBI and its databases
Week 2	Using NCBI Tools for Sequence Retrieval and Analysis	Practical: Retrieve a sequence from NCBI and analyze it
Week 3	Introduction to DDBJ: Features and applications	Read: Overview of DDBJ and its usage in bioinformatics
Week 4	Using DDBJ for Sequence Data Retrieval	Practical: Retrieve and annotate a sequence from DDBJ
Week 5	Primer3: Introduction to Primer3 tool for primer design	Assignment: Design primers using Primer3 for a given sequence
Week 6	Practical Use of Primer3 for PCR Primer Design	Practical: Design primers using Primer3 and analyze results

Week 7	Primer Fox: Introduction and features of Primer Fox	Read: Overview and applications of Primer Fox in bioinformatics
Week 8	Designing Primers using Primer Fox	Practical: Design primers using Primer Fox tool
Week 9	BLAST: Introduction to BLAST for sequence alignment	Practical: Perform a BLAST search for sequence comparison
Week 10	Using BLAST for Sequence Similarity Search	Assignment: Interpret BLAST results and identify sequence matches
Week 11	NEB Cutter: Introduction to NEB Cutter for restriction enzyme analysis	Read: Overview of NEB Cutter and its applications
Week 12	Practical Use of NEB Cutter for Restriction Site Analysis	Practical: Use NEB Cutter to analyze restriction enzyme sites
Week 13	Advanced Features of BLAST and NEB Cutter	Practical: Perform advanced analysis using BLAST and NEB Cutter
Week 14	Integrating NCBI, DDBJ, Primer3, Primer Fox, BLAST, and NEB Cutter	Assignment: Use multiple tools for sequence analysis and report findings
Week 15	Review of Bioinformatics Tools Learned	Review: Revisit all tools and prepare a summary of practical usage
Week 16	Final Practical Project: Application of Tools for a Research Question	Submit and present final project using the tools learned in the course

Textbooks and Reading Material

- Attwood, T. K., & Parry-Smith, D. J. Introduction to Bioinformatics. Pearson.
- Lesk, A. M. Introduction to Bioinformatics. Oxford University Press.
- Mount, D. W. Bioinformatics: Sequence and Genome Analysis. Cold Spring Harbor Laboratory Press.
- Durbin, R., Eddy, S. R., Krogh, A., & Mitchison, G. Biological Sequence Analysis: Probabilistic Models of Proteins and Nucleic Acids. Cambridge University Press.
- Pevzner, P. A. Computational Molecular Biology: An Introduction. MIT Press.
- Baldi, P., & Sørensen, D. Bioinformatics: The Machine Learning Approach. MIT Press.
- Zvelebil, M. J., & Baum, J. O. Understanding Bioinformatics. Garland Science.

Teaching Learning Strategies

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   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation

4. Professional Writing Assignments			
Assessment			
Sr. No.	**Elements**	**Weightage**	**Details**
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
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3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-311	Credit Hours	3(2+1)
Course Title	Clinical Parasitology				

Course Introduction

The course in Cytopathology and Endocrinology with a focus on Parasitology provides students with in-depth knowledge and practical experience in identifying parasitic infections, specifically protozoans and malarial parasites, through laboratory techniques. It introduces students to the principles and practices in parasitology laboratories, emphasizing the use of laboratory equipment, maintenance protocols, and proper identification methods for various parasitic organisms. The course covers the detailed detection and identification of common protozoa, including *Entamoeba histolytica*, other *Entamoeba* species, *Giardia lamblia*, and malarial parasites. Through this course, students will gain hands-on experience in stool examination, microscopy, and visual presentation techniques, which are essential skills in the diagnosis and study of parasitic diseases.

Learning Outcomes

On the completion of the course, the students will:

- **Identify and understand the function of equipment** used in parasitology laboratories, demonstrating knowledge of their principles, uses, and maintenance.
- **Examine and analyze stool samples** for the presence of parasitic infections, with a particular focus on protozoan and malarial parasites.
- **Detect and identify *Entamoeba histolytica*** using microscopy, including differentiating it from other *Entamoeba* species.
- **Identify and understand the lifecycle and clinical significance of *Giardia lamblia*,** and accurately identify it in stool samples.
- **Detect and identify malarial parasites** in blood smears, recognizing their different stages and understanding their significance in diagnosing malaria.
- **Demonstrate proficiency in visual presentation techniques** for protozoan and malarial parasite identification, preparing clear and informative presentations for educational purposes.
- **Apply the knowledge gained from practical exercises** to accurately diagnose parasitic infections, contributing to effective clinical decision-making.
- **Understand and follow laboratory safety protocols** and maintenance routines to ensure a safe and efficient parasitology laboratory environment.

Course Content (Theory)		Assignments/Readings
Week 1	Introduction to Parasitology: Overview and importance	Read: Introduction to Parasitology
	Taxonomy and Classification of Parasites: Methods and systems	Assignment: Research and create a parasite classification chart
Week 2	Quality Control in Stool Examination: Techniques and procedures	Practical: Perform a stool examination for parasites
	Entamoeba histolytica: Life cycle, pathogenesis, and diagnosis	Read: Information on **Entamoeba histolytica** and related case studies
Week 3	Comparative Study of Other **Entamoeba** Species	Assignment: Compare the characteristics of **E. histolytica** and other Entamoeba species
	Giardia lamblia: Morphology, clinical features, and diagnosis	Read: Information on **Giardia lamblia** and its epidemiology
Week 4	**Naegleria fowleri** and **Acanthamoeba**: Clinical significance and diagnosis	Assignment: Research the clinical importance of **Naegleria fowleri**
	Trichomonas vaginalis: Life cycle, pathogenesis, and diagnosis	Read: Information on **Trichomonas vaginalis** infections
Week 5	**Cryptosporidium**: Pathogenesis, diagnosis, and clinical manifestations	Practical: Diagnostic techniques for **Cryptosporidium**

	Blood Flagellates: Introduction to Trypanosomiasis	Read: Overview of Trypanosomiasis and the flagellates involved
Week 6	**African Trypanosomiasis**: Symptoms, diagnosis, and treatment	Assignment: Study the symptoms and pathogenesis of **African Trypanosomiasis**
	American Trypanosomiasis: Diagnosis and treatment	Practical: Examine blood smears for Trypanosoma species
Week 7	**Leishmania**: Introduction, classification, and life cycle	Read: Information on **Leishmania** species and leishmaniasis
	Cutaneous, Mucocutaneous, and Visceral Leishmaniasis: Diagnosis and treatment	Assignment: Compare the clinical features of different forms of leishmaniasis
Week 8	Blood Sporozoa: Introduction to **Plasmodium** Species and Malaria	Read: Study the life cycle and pathology of **Plasmodium** species
	Plasmodium Species: Pathology, pathogenesis, and epidemiology	Practical: Microscopic examination of **Plasmodium** species
Week 9	Tissue Sporozoa: **Toxoplasma gondii**: Life cycle and clinical features	Assignment: Study and discuss the clinical implications of **Toxoplasma gondii**
	Intestinal Helminths: Overview of **Enterobius vermicularis** and **Trichuris trichiura**	Read: Information on intestinal helminths and their treatments
Week 10	**Ascaris lumbricoides** and **Ancylostoma duodenale**: Diagnosis and clinical manifestations	Practical: Identification of **Ascaris lumbricoides** in stool samples
	Strongyloides stercoralis: Life cycle and clinical features	Assignment: Research the pathogenesis of **Strongyloides stercoralis**
Week 11	**Taenia saginata** and **Taenia solium**: Life cycle, diagnosis, and clinical implications	Practical: Identification of **Taenia solium** and **Taenia saginata**
	Blood and Tissue Helminths: Overview of **Schistosoma** Species	Read: Information on **Schistosoma** species and schistosomiasis
Week 12	**Taenia solium**: Diagnosis, pathology, and treatment	Assignment: Discuss the pathology and treatment of **Taenia solium** infections
	Echinococcus granulosus: Life cycle, pathology, and diagnostic methods	Practical: Examine tissue samples for **Echinococcus** cysts
Week 13	Overview of Helminthic Infections: Diagnosis and treatment strategies	Read: Information on treatment options for helminthic infections
	Parasitic Infections: Diagnostic techniques for identifying protozoa and helminths	Practical: Microscopic examination of stool and blood samples
Week 14	Epidemiology of Parasitic Infections: Global distribution and risk factors	Assignment: Research the global impact of parasitic diseases
	Pathogenesis of Parasitic Diseases: Host-parasite interactions	Read: Case studies on parasitic diseases and their pathogenesis
Week 15	Clinical Management of Parasitic Infections: Treatment and prevention	Assignment: Create a treatment guideline for a selected parasitic infection
	Case Studies in Clinical Parasitology: Analysis and discussion	Practical: Discuss case studies involving parasitic infections
Week 16	Review of Protozoal and Helminthic Infections	Review: Prepare a summary of protozoa and helminths covered in the course
	Final Examination and Course Wrap-up: Discussion of key concepts and treatments	Final Exam: Covering all topics from the course

Course Content (Lab)		Assignments/Readings
Week 1	Identification of Equipment used in parasitology laboratory	Read the equipment manual and prepare a report on the types of equipment used in parasitology labs.
Week 2	Principles of parasitology laboratory techniques	Review and summarize key principles in parasitology laboratory practices.
Week 3	Uses of parasitology laboratory equipment	Prepare a detailed list of common parasitology laboratory tools and their uses.
Week 4	Maintenance of parasitology laboratory equipment	Write an essay on proper maintenance and safety protocols for laboratory equipment.
Week 5	Demonstration of protozoan visual presentation	Prepare a visual presentation showcasing different protozoans observed under a microscope.
Week 6	Stool examination for parasitic infections	Conduct a stool examination and prepare a report on the findings.
Week 7	Detection and identification of *Entamoeba histolytica*	Review literature on *Entamoeba histolytica* and prepare an identification chart.
Week 8	Detection and identification of other *Entamoeba* species (Microscopy)	Identify and differentiate between *Entamoeba histolytica* and other *Entamoeba* species under a microscope.
Week 9	Visual presentation of other *Entamoeba* species	Create a presentation comparing various *Entamoeba* species with images and characteristics.
Week 10	Detection and identification of *Giardia lamblia*	Review diagnostic techniques for *Giardia lamblia* and prepare a comparison table.
Week 11	Identification of *Giardia lamblia* using microscopy	Perform microscopy and create a report on identifying *Giardia lamblia*.
Week 12	Detection and identification of malarial parasites	Study and report on various methods used to detect malarial parasites in blood smears.
Week 13	Microscopic identification of malarial parasites	Conduct a blood smear examination for malaria and document the findings.
Week 14	Visual presentation of malarial parasites	Prepare a presentation on the morphology of different stages of malarial parasites.
Week 15	Revision of protozoan and parasitic identification techniques	Revise all previously studied protozoan species and prepare a comprehensive report.
Week 16	Final assessment and practical exam on parasitic identification	Complete a practical exam on the identification of protozoans, including *Entamoeba* and *Giardia* species, as well as malarial parasites.
Textbooks and Reading Material		

- Jawetz, Melnick, & Adelberg. Medical Microbiology. 26th edition. Mc Graw Hill Medical, New York. Levinson, W. Review of Medical Microbiology and Immunology, 12th Edition, Mc Graw Hill Medical, New York.

Teaching Learning Strategies

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2. Quiz-II
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Programme	Medical Laboratory Technology	Course Code	MLT-312	Credit Hours	3(2+1)
Course Title	Chemical Pathology				

Course Introduction

Chemical Pathology is the study of biochemical processes and laboratory techniques used to diagnose diseases. It focuses on understanding metabolic disorders, enzymology, organ function tests, and molecular diagnostics. The course equips students with the knowledge to analyze lab results, interpret clinical data, and apply diagnostic methods in healthcare settings.

Learning Outcomes

On the completion of the course, the students will:

- Grasp the basic principles and significance of biochemical markers in disease diagnosis and monitoring.
- Interpret common laboratory test results and their clinical implications.
- Evaluate biochemical abnormalities in metabolic and endocrine disorders.
- Understand the biochemical changes in diseases like liver, kidney, cardiovascular, and cancers.
- Integrate laboratory data into clinical decision-making for patient management.
- Acquire hands-on laboratory skills in chemical analysis and instrumentation.
- Appreciate quality control, ethical considerations, and the role of chemical pathology in clinical practice

Course Content (Theory)		Assignments/Readings
Week 1	Introduction to Chemical Pathology: Overview and Scope	Read the introduction to chemical pathology
	Basic Principles of Biochemical Analysis	Review laboratory techniques used in chemical pathology
Week 2	Biochemical Components of Blood: Proteins, Carbohydrates, Lipids	Study the composition and function of blood components
	Blood Plasma Proteins: Functions and Abnormalities	Assignment: Research on protein abnormalities in disease
Week 3	Enzyme Function and Diagnostic Enzymology	Review the role of enzymes in biochemical testing
	Clinical Applications of Enzymes in Disease Diagnosis	Assignment: Case study on enzyme levels in disease diagnosis
Week 4	Disorders of Lipid Metabolism: Hyperlipidemia and Atherosclerosis	Study the biochemical causes and clinical impact of lipid metabolism disorders
	Cholesterol and Lipid Profile Analysis	Lab Report: Analyze lipid profiles in clinical scenarios
Week 5	Carbohydrate Metabolism Disorders: Diabetes and Hypoglycemia	Study the role of insulin, glucose metabolism, and related disorders
	Clinical Applications of Glucose Testing	Assignment: Study on glucose testing in diabetes management
Week 6	Renal Function and Disorders: Blood Urea Nitrogen (BUN) and Creatinine	Study the biochemical tests used to assess kidney function
	Interpretation of Kidney Function Tests	Assignment: Case study on diagnosing renal diseases based on lab results

Week 7	Liver Function Tests and Bilirubin Metabolism	Study the biochemical processes in the liver and their clinical tests
	Jaundice and Hepatic Enzyme Abnormalities	Lab Practice: Interpreting liver function test results
Week 8	Electrolyte Imbalances: Sodium, Potassium, Calcium	Study the role of electrolytes in health and disease
	Disorders of Electrolyte Homeostasis	Review the diagnosis of electrolyte imbalances in clinical practice
Week 9	Acid-Base Imbalances: pH, CO_2, and HCO_3	Study how pH, CO_2, and HCO_3 are regulated and their clinical importance
	Diagnosis of Respiratory and Metabolic Acidosis/Alkalosis	Assignment: Clinical case study on diagnosing acid-base disorders
Week 10	Endocrine Disorders: Thyroid, Adrenal, and Pituitary Glands	Study the biochemical basis of endocrine disorders and their tests
	Hormone Levels in Diagnosing Endocrine Disorders	Assignment: Analysis of thyroid and adrenal function tests
Week 11	Metabolic Bone Disorders: Osteoporosis, Rickets, Osteomalacia	Study the biochemical tests for assessing bone health and metabolic bone diseases
	Calcium and Phosphorus Disorders in Bone Diseases	Lab Report: Analyzing calcium and phosphorus levels in patients
Week 12	Vitamin and Mineral Deficiencies: Iron, Vitamin D, B12	Study the role of micronutrients in health and the effects of deficiencies
	Analysis of Nutritional Deficiencies	Assignment: Case study on vitamin B12 and iron deficiencies
Week 13	Tumor Markers in Cancer Diagnosis: Biochemical Indicators	Study the use of biochemical markers in cancer detection and prognosis
	Clinical Use of Tumor Markers	Assignment: Research on clinical applications of tumor markers
Week 14	Genetic and Molecular Diagnostics in Chemical Pathology	Study genetic testing techniques used in chemical pathology
	Applications of PCR and Genetic Testing	Lab Activity: Introduction to PCR and molecular diagnostic techniques
Week 15	Clinical Chemistry in Disease Surveillance	Review all topics covered in the course for practical applications
	Ethical and Legal Issues in Chemical Pathology	Final Project: Ethical considerations in the use of chemical pathology in clinical practice

Week 16	Review and Integration of Course Content	Prepare for Final Exam
	Practical Applications in Allied Health Sciences	Review and discuss key concepts for the final exam
Course Content (Lab)		**Assignments/Readings**
Week 1	Introduction to Laboratory Safety and Equipment	Read on lab safety protocols and basic equipment
Week 2	Blood Sample Collection and Preparation (Serum/Plasma)	Study the proper technique for blood sample collection
Week 3	Glucose Testing: Fast and Postprandial Blood Glucose Levels	Review glucose metabolism and testing methods
Week 4	Lipid Profile Testing: Total Cholesterol, HDL, LDL, Triglycerides	Study lipid metabolism and its clinical significance
Week 5	Liver Enzyme Tests: ALT, AST, ALP, GGT	Read about the diagnostic role of liver enzymes
Week 6	Renal Function Tests: BUN and Creatinine Analysis	Study renal function and its biochemical markers
Week 7	Liver Function Tests: Bilirubin, Albumin, and Total Protein	Read on liver function and related tests
Week 8	Electrolyte Imbalances: Sodium, Potassium, Calcium	Study the role of electrolytes and their imbalances
Week 9	Acid-Base Balance: Blood Gas Testing (pH, CO2, HCO3)	Study acid-base homeostasis and its clinical importance
Week 10	Thyroid Function Tests: TSH, T3, and T4 Levels	Review thyroid disorders and diagnostic testing methods
Week 11	Bone Mineral Testing: Calcium and Phosphorus Levels	Study the relationship between bone health and mineral levels
Week 12	Iron Studies: Serum Iron, Ferritin, and Transferrin Saturation	Review iron metabolism and diagnostic tests for anemia
Week 13	Tumor Markers: CEA, PSA, CA-125, and their Clinical Use	Study the role of tumor markers in cancer diagnosis
Week 14	PCR and Genetic Testing: Basics of DNA Extraction and Amplification	Study molecular biology techniques used in diagnostics
Week 15	Review of All Diagnostic Tests: Hands-on Practical Review	Revisit all tests learned during the course
Week 16	Final Practical Exam: Comprehensive Diagnostic Testing	Prepare for final practical exam on all tests performed

Textbooks and Reading Material

- **"Clinical Chemistry: Principles, Techniques, and Correlations" (8th Edition)** by William J. Marshall and Stephen K. Bangert (2020)
- **"Tietz Textbook of Clinical Chemistry and Molecular Diagnostics" (7th Edition)** by Carl A. Burtis, David E. Bruns, Edward R. Ashwood, and George R. Blankenberg (2015)
- **"Basic Clinical Laboratory Techniques" (8th Edition)** by Barbara H. Estridge (2021)
- **"Fundamentals of Clinical Chemistry" (5th Edition)** by Norman W. Tietz (2012)
- **"Medical Biochemistry" (4th Edition)** by John W. Baynes and Marianna Hermana Dominiczak (2014)
- **"Clinical Laboratory Science: The Basics and Routine Techniques" (6th Edition)** by Jean Jorgensen (2021)

Teaching Learning Strategies

1. **Interactive Lectures**

Engage students with interactive presentations, discussions, and real-time corrections of writing and speaking errors.

2. **Collaborative Learning**
   Students will work in pairs or small groups to write essays, analyze readings, and give peer feedback on presentations.
3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-401	Credit Hours	3(2+1)
Course Title	Health Biotechnology				

Course Introduction

The **Health Biotechnology** course introduces students to the application of biotechnology in healthcare, including genetic engineering, biopharmaceuticals, diagnostics, and gene therapies. Students will gain an understanding of biotechnological techniques, ethical issues, regulatory frameworks, and emerging trends, preparing them for careers in medical research and biotechnology innovation.

Learning Outcomes

On the completion of the course, the students will:

- Understand fundamental biotechnology principles in healthcare.
- Explore biotechnological applications in drug development and diagnostics.
- Analyze genetic engineering and genomic medicine techniques.
- Evaluate ethical, legal, and regulatory issues in health biotechnology.
- Investigate emerging trends and innovations in biotechnology.

Course Content (Theory)		Assignments/Readings
Week 1	Introduction to Health Biotechnology; Overview of the course.	Read : Introduction to Health Biotechnology
	Social acceptance of medical biotechnology.	Read articles on public perception of biotechnology
Week 2	Molecular basis of disease; DNA, RNA, and protein function in health and disease.	Review key molecular mechanisms in disease
	Molecular and genetic markers in health.	Study examples of genetic markers in disease
Week 3	Detection of mutations and infectious agents.	Research on mutation detection techniques
	Active immunization: Principles and types of vaccines.	Read about vaccine types and their uses
Week 4	Passive immunization and immunoglobulins.	Review the use of passive immunization in healthcare
	Live, killed, recombinant DNA vaccines.	Prepare notes on vaccine classification and mechanisms
Week 5	Subunit vaccines and DNA vaccines.	Read on the technology behind subunit and DNA vaccines
	Edible vaccines: Concepts and development.	Research edible vaccines in plants
Week 6	Organ transplantation: Immunology and rejection mechanisms.	Review organ rejection case studies
	Applications of transgenic animals: Animal models of diseases.	Study transgenic animal models and their applications
Week 7	Transgenic animals in farming and enhancement of farm animals.	Prepare a report on transgenic animals in agriculture
	Drug delivery systems: Mechanisms and types.	Read about different drug delivery techniques
Week 8	Blood transfusion techniques and immunology of blood types.	Review blood transfusion protocols
	Grafting techniques and tissue compatibility.	Study tissue grafting and immune responses

Week 9	Pharmacogenetics: Genetic influence on drug response.	Research case studies on pharmacogenetics
	Introduction to gene therapy and its applications.	Prepare an overview on gene therapy technologies
Week 10	Gene editing technologies: CRISPR-Cas9.	Read on CRISPR-Cas9 technology and its uses
	Biopharmaceuticals from plants: Production and benefits.	Research the role of plants in biopharmaceuticals
Week 11	Stem cell technology: Types and applications in health.	Read on stem cell therapies and applications
	Ethical issues in biotechnology.	Prepare a discussion on ethical considerations
Week 12	Clinical applications of biotechnology: Personalized medicine.	Review personalized medicine case studies
	Biotechnology in diagnostics: Molecular tools and techniques.	Study diagnostic applications in molecular biology
Week 13	Advanced immunization strategies: Adjuvants and delivery systems.	Research adjuvants and their role in vaccines
	Cancer biotechnology: Molecular targets and treatments.	Read articles on biotechnology in cancer treatment
Week 14	Biotechnological approaches in infectious disease control.	Research biotechnological tools in infectious diseases
	Nanotechnology in health biotechnology: Applications and challenges.	Prepare a report on nanotech applications in healthcare
Week 15	Biotechnology and the human genome project.	Study the human genome project and its implications
	Emerging trends in biotechnology: Future prospects.	Read on future trends in medical biotechnology
Week 16	Review of key concepts: Diseases, treatments, and biotechnology applications.	Review all course materials
	Final Exam Preparation: Summary and wrap-up.	Study for final exam and revise course materials
Course Content (Lab)		**Assignments/Readings**
Week 1	Introduction to molecular diagnostics and genetic markers.	Read Overview of molecular diagnostics.
Week 2	DNA extraction techniques from different biological samples.	Prepare a report on DNA extraction methods.
Week 3	PCR (Polymerase Chain Reaction): Principles and applications.	Review PCR techniques and their diagnostic uses.
Week 4	Primer design for PCR amplification of target genes.	Read on primer design and PCR optimization techniques.
Week 5	Gel electrophoresis: DNA analysis and visualization.	Prepare notes on gel electrophoresis procedures.
Week 6	Quantitative PCR (qPCR) and real-time PCR for gene expression.	Research applications of qPCR in diagnostics.
Week 7	Restriction fragment length polymorphism (RFLP) analysis.	Study RFLP techniques in genetic diagnostics.
Week 8	Genotyping methods: SNP (Single Nucleotide Polymorphisms) detection.	Review SNP genotyping techniques and their clinical applications.
Week 9	DNA sequencing techniques: Sanger sequencing and next-gen sequencing (NGS).	Read about sequencing technologies and their diagnostic uses.
Week 10	DNA microarrays for gene expression profiling.	Prepare a report on DNA

		microarray technology.
Week 11	Southern blotting: Application in genetic marker detection.	Study Southern blotting methodology.
Week 12	Northern blotting and its diagnostic applications.	Review Northern blot technique and its uses in diagnostics.
Week 13	Gene mutations and their detection using molecular techniques.	Research common genetic mutations and diagnostic methods.
Week 14	High-throughput screening techniques in molecular diagnostics.	Study the principles of high-throughput screening methods.
Week 15	Diagnostic applications of molecular markers in infectious diseases.	Review diagnostic methods for infectious diseases using molecular markers.
Week 16	Practical review and final assessment on molecular diagnostic techniques.	Revise all practical techniques covered in the course.

Textbooks and Reading Material

- Clinical Molecular Medicine (2nd Edition, 2022)**,** Author: Robin R. McKinney, Jonathan A. Sosman
- Diagnostic Molecular Pathology (3rd Edition, 2023), Author: Lira K. R. De Oliveira,
- Molecular Diagnostics: Fundamentals, Methods, and Clinical Applications (3rd Edition, 2020), Author: Lela Buckingham, David J. Maloney
- Bustillo LGT and Pena IG, 2012. Biotechnology: Health, Food, Energy and Environment Applications (Biotechnology in Agriculture, Industry and Medicine). Nova Science Publication.
- Dogramatzis, 2010. Health care Biotechnology. 1st Edition; CRC Press

Teaching Learning Strategies

1. **Interactive Lectures**
   Engage students with interactive presentations, discussions, and real-time corrections of writing and speaking errors.
2. **Collaborative Learning**
   Students will work in pairs or small groups to write essays, analyze readings, and give peer feedback on presentations.
3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

Quiz-1, Quiz-II, Presentation, Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%.

3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	**Course Code**	**MLT-402**	**Credit Hours**	3(2+1)
Course Title	Immunohematology and Transfusion Medicine				

Course Introduction

Immunohematology and Transfusion Medicine is a specialized area of clinical laboratory science that focuses on the study of blood and its components in the context of blood transfusion. This course provides an in-depth understanding of the immunological principles underlying blood group systems, compatibility testing, transfusion reactions, and therapeutic applications of blood and its derivatives. It is designed to equip students with the theoretical knowledge and practical skills necessary for the safe and effective management of blood transfusions, as well as the application of laboratory techniques used in blood typing, antibody screening, crossmatching, and compatibility testing.

The course also covers the advanced aspects of transfusion medicine, including the management of blood bank operations, donor screening, collection, storage, and the latest advancements in blood transfusion therapies. Students will be introduced to the ethical, legal, and regulatory aspects surrounding transfusion practices, ensuring safe and effective patient care.

Learning Outcomes

On the completion of the course, the students will:

- Understand blood group systems (ABO, Rh, and other systems).
- Perform blood typing and compatibility testing (including crossmatching).
- Identify transfusion reactions and manage them appropriately.
- Explain blood component therapy and its clinical applications.
- Conduct donor screening and blood collection procedures.
- Understand ethical, legal, and regulatory aspects of transfusion medicine.
- Use laboratory technology in immunohematology testing.
- Apply transfusion medicine principles in clinical scenarios.
- Ensure safety and quality in blood transfusion practices.
- Stay updated on advances in transfusion medicine and related technologies.

Course Content (Theory)		Assignments/Readings
Week 1	General Introduction to Immunohematology and Blood Banking	Read Overview of Immunohematology and Blood Banking
	Antigen-Antibody Concept; Precipitation and Flocculation	Review antigen-antibody interactions and their diagnostic use
Week 2	General Management and Essential Components of Blood Bank	Study the components and functions of a blood bank
	ABO Blood Group System: Inheritance and Distribution	Read on ABO inheritance patterns and antibody types
Week 3	Antibodies in ABO System; Subgroups of ABO Blood Group System	Research the different subgroups of ABO and their clinical significance
	ABO Grouping Methods and Factors Influencing Blood Grouping	Study ABO grouping methods and their clinical applications
Week 4	Rh Blood Group System: Inheritance, Distribution, and Antibodies	Review Rh blood group inheritance and antibody characteristics
	Hemolytic Disease of Newborn; Rh Typing Methods	Read case studies on Rh incompatibility and diagnostic methods
Week 5	Other Blood Group Systems: NS Blood Group, P Blood	Study the characteristics of these

	Group, Lutheran Blood Group, Kell Blood Group	lesser-known blood groups
	Lewis Blood Group, Duffy Blood Group, Kidd Blood Group, Bombay Blood Group	Research the distribution and clinical significance of these blood groups
Week 6	Blood Transfusion: Overview and Basic Principles	Read about the history and importance of blood transfusion
	Donor Screening: Process, Criteria, and Safety Considerations	Review donor screening guidelines and requirements
Week 7	Collection of Blood: Methods and Equipment	Prepare notes on blood collection techniques and safety measures
	Screening of Blood: Tests and Methods for Detecting Infectious Agents	Research screening tests used for blood donations
Week 8	Anticoagulants Used in Blood Bank; Their Role and Applications	Read on common anticoagulants used in blood banking
	Storage of Blood: Procedures, Requirements, and Safety Standards	Study blood storage conditions and preservation methods
Week 9	Transfusion Reactions: Types, Causes, and Symptoms	Review transfusion reaction case studies
	Principles and Methods of Investigating Transfusion Reactions	Study diagnostic procedures for investigating transfusion reactions
Week 10	Diseases Transmitted by Blood Transfusion: Prevention and Management	Research bloodborne diseases and their prevention during transfusion
	Component Therapy: Preparation of Leucocyte-Poor Blood and RBC Concentrate	Prepare a report on blood component separation and transfusion
Week 11	Preparation and Transfusion of Platelet-Rich Plasma, Platelet Concentrate, and Factor VIII	Study clinical uses and methods for preparing blood components
	Transfusion of Plasma: Indications and Preparation	Review clinical applications of plasma transfusions
Week 12	Cryoprecipitate: Preparation, Uses, and Advantages	Research the use of cryoprecipitate in clinical practice
	Blood Compatibility Testing: Crossmatching, Blood Grouping and Antibody Screening	Study practical methods of blood compatibility testing
Week 13	Red Blood Cell (RBC) Transfusion: Indications, Risks, and Best Practices	Review RBC transfusion protocols and risk management strategies
	Platelet and Plasma Transfusion: Techniques and Therapeutic Applications	Read about platelet and plasma transfusion protocols
Week 14	Blood Bank Quality Control: Ensuring Safety in Transfusion Practices	Study quality assurance measures in the blood bank
	Transfusion in Special Populations: Neonates, Pregnant Women, and Immunocompromised Patients	Research transfusion considerations for special patient groups
Week 15	Emerging Trends in Transfusion Medicine: Autologous Transfusion, Blood Substitutes	Review the latest advancements and technologies in transfusion medicine
	Ethical and Legal Aspects of Transfusion Medicine: Consent, Responsibility, and Regulations	Prepare a discussion on ethical and legal considerations in transfusion medicine
Week 16	Review of Key Concepts: Blood Group Systems, Transfusion Reactions, and Blood Component Therapy	Revise all course materials for final exam preparation
	Final Exam Review: Summary of Immunohematology and Transfusion Medicine Concepts	Study for final exam and review practical applications
Course Content (Lab)		**Assignments/Readings**

Week 1	Test for Du Antigen: Principles and Methods	Read Chapter on Du antigen testing methods and their clinical relevance
Week 2	Major Crossmatching: Procedure and Interpretation	Review major crossmatching technique and case studies
Week 3	Minor Crossmatching: Procedure and Interpretation	Study minor crossmatching methodology and its clinical significance
Week 4	Coombs Crossmatching: Indications and Techniques	Prepare a report on Coombs crossmatching and its use in transfusion
Week 5	Coombs Test - Direct: Procedure and Interpretation	Read about direct Coombs test and its role in detecting hemolytic anemia
Week 6	Coombs Test - Indirect: Procedure and Interpretation	Study indirect Coombs test methodology and its diagnostic uses
Week 7	Screening of Blood for Infectious Agents: Overview and Techniques	Read on blood screening procedures and their importance in transfusion medicine
Week 8	HIV Testing: Techniques and Interpretation	Review HIV screening tests used in blood donations and transfusions
Week 9	HBV (Hepatitis B) Screening: Methods and Interpretation	Study the importance of HBV screening in blood banking
Week 10	HCV (Hepatitis C) Screening: Methods and Interpretation	Read on the techniques for HCV screening and transfusion safety
Week 11	V.D.R.L. (Venereal Disease Research Laboratory) Test for Syphilis	Prepare notes on V.D.R.L. testing methods and their application in blood screening
Week 12	Malaria Screening: Techniques and Procedures	Study malaria screening methods and their relevance in blood donation
Week 13	Blood Screening for Other Infectious Agents: Overview of Additional Tests	Review screening protocols for other infectious agents (e.g., HTLV, CMV)
Week 14	Practical Application of Compatibility Testing: Case Studies and Simulations	Complete a practical exercise in crossmatching and Coombs testing
Week 15	Quality Control and Troubleshooting in Blood Screening and Compatibility Tests	Study quality control measures in immunohematology and transfusion medicine
Week 16	Final Practical Assessment: Testing and Interpretation of Blood Compatibility and Screening Results	Review and prepare for the final practical exam based on all techniques covered

Textbooks and Reading Material

- Immunohematology: Principles and Practice (4th Edition, 2023) by Denise M. Harmening
- Molecular Blood Grouping (2nd Edition, 2021) by Frank L. O'Connell, Daniel D. Bessman
- Basic and Advanced Laboratory Techniques in Immunohematology (2022) by Shizuko W. Yoshida
- Transfusion Medicine: A Clinical Guide (3rd Edition, 2022) by Alok A. Gupta, David J. Roberts
- Blood Banking and Transfusion Medicine: Basic Principles and Practice (4th Edition, 2021) by Christopher D. Hillyer, Laura A. Lanteri
- Practical Blood Transfusion (5th Edition, 2020) by A. K. Gupta
- Clinical Hematology: Theory and Procedures (7th Edition, 2023) by Mary Louise Turgeon

Quinley. Immunohematology: principles and practice. Philadelphia: Lippincott; 1998 Jan.

- Klein HG, Anstee DJ. Mollison's blood transfusion in clinical medicine. John Wiley & Sons; 2008. Harmening DM. Modern blood banking and transfusion practices. FA Davis; 2012.

Teaching Learning Strategies

1. **Interactive Lectures**
   Engage students with interactive presentations, discussions, and real-time corrections of writing and speaking errors.
2. **Collaborative Learning**
   Students will work in pairs or small groups to write essays, analyze readings, and give peer feedback on presentations.
3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-403	Credit Hours	3(2+1)
Course Title	Artificial Intelligence in Lab Sciences				

Course Introduction

The **Artificial Intelligence in Laboratory Sciences** course explores the integration of AI technologies in laboratory settings, focusing on data analysis, automation, diagnostic tools, and decision-making processes to enhance efficiency and accuracy in laboratory practices.

Learning Outcomes

On the completion of the course, the students will:

- Understand the fundamental concepts of AI and its applications in laboratory sciences.
- Analyze and apply machine learning techniques to laboratory data for improved diagnostics.
- Implement AI-based automation tools to optimize laboratory workflows.
- Develop skills in using AI-driven software for data interpretation and decision support.
- Evaluate ethical considerations and challenges in the use of AI in laboratory settings.

	Course Content (Theory)	Assignments/Readings
Week 1	Introduction to AI in Laboratory Sciences: Overview of the course, objectives, and role of AI in lab research	Read: Introduction to AI in Laboratory Sciences
	Machine Learning Fundamentals: Concepts, algorithms, and relevance in lab data analysis	Review basic machine learning algorithms and their lab applications
Week 2	Machine Learning Techniques: Supervised and unsupervised learning in laboratory data	Study different machine learning models and their uses in labs
	AI in Data Acquisition: Automating data collection, instrument control, and sensor integration	Read on AI tools for data acquisition in laboratory settings
Week 3	AI for Data Analysis and Interpretation: Pre-processing, pattern recognition, and predictive analytics	Study AI techniques for scientific data analysis and interpretation
	Natural Language Processing (NLP) in Research: Extracting insights from textual data sources like research papers	Research NLP methods for text analysis in lab sciences
Week 4	NLP Techniques in Laboratory Research: Applications in literature mining and report generation	Review case studies on NLP usage in scientific research
	Robotics and Automation: AI-driven robotics for sample handling, testing, and experimentation	Read on the use of robotics and AI in laboratory automation
Week 5	AI in Experimental Design: Optimizing designs, parameter selection, and hypothesis testing	Study AI applications in experimental design and optimization
	AI for Quality Control: Ensuring data quality and reproducibility through AI-driven QC measures	Prepare notes on AI for maintaining quality control in lab settings
Week 6	Ethical Considerations: Ethical implications of AI in lab research, including bias, privacy, and responsible AI	Read about the ethical challenges in AI applications in laboratory sciences
	Ethical AI in Practice: Addressing privacy concerns and bias in AI systems	Research ethical case studies in AI applications
Week 7	AI Integration Challenges: Identifying and solving challenges in AI integration into laboratory workflows	Prepare a report on common challenges when integrating AI in labs
	Overcoming AI Integration Barriers: Solutions and strategies for effective AI implementation in labs	Read on strategies for overcoming AI integration barriers
Week 8	Case Studies in AI Applications: Successful AI applications in various laboratory sciences	Review real-world case studies showcasing AI in laboratory

		research
	Case Studies Continued: In-depth analysis of AI applications in specific lab fields	Prepare a case study analysis of AI applications in labs
Week 9	AI in Clinical Laboratories: Applications of AI in clinical and diagnostic laboratories	Study AI technologies in clinical lab settings
	AI in Environmental and Biological Research: AI-driven solutions in environmental monitoring and biology	Read on AI applications in environmental and biological research
Week 10	AI for Drug Discovery: AI applications in pharmaceutical and biotechnology research	Research AI's role in drug discovery and biotechnology
	Future Trends: Emerging AI technologies and their impact on future lab research	Read about upcoming AI technologies and trends in lab sciences
Week 11	AI and Big Data: Leveraging big data analytics in laboratory settings using AI tools	Study big data applications in lab sciences
	AI in Genomic Research: AI's role in genomics and personalized medicine	Review AI tools used in genomic and genetic research
Week 12	AI in Proteomics and Metabolomics: Applications in protein and metabolite analysis	Prepare notes on AI in proteomics and metabolomics research
	AI for Automation in Laboratory Workflow: Streamlining processes using AI-driven automation tools	Research laboratory automation techniques using AI
Week 13	AI and Real-Time Data Processing: AI tools for real-time monitoring and data analysis	Study real-time data processing in laboratories with AI
	Implementing AI in Lab Research: Practical approaches for integrating AI in day-to-day lab operations	Prepare a guide for implementing AI in lab research environments
Week 14	Challenges in AI Adoption in Labs: Barriers to AI adoption and potential solutions	Research challenges in adopting AI in laboratories
	AI and Lab Safety: Enhancing lab safety through AI-driven predictive models	Read on how AI can improve safety in laboratory environments
Week 15	Regulatory and Compliance Issues: Legal and regulatory aspects of AI in lab sciences	Study the regulations surrounding AI applications in laboratory sciences
	Industry Perspectives: Insights from industry leaders on the future of AI in lab sciences	Review interviews and reports from AI industry experts
Week 16	Review and Integration: Review of key AI concepts and their practical applications in laboratory sciences	Revise all course materials for final exam preparation
	Final Exam Review: Summary and application of AI in laboratory sciences	Final exam preparation and review of course topics
Course Content (Lab)		**Assignments/Readings**
Week 1	Introduction to AI Tools and Software: Overview of AI tools used in lab sciences	Read Introduction to AI Tools and Software in Lab Sciences
Week 2	Overview of Machine Learning Basics in Laboratory Applications	Study basic machine learning algorithms and their lab applications
Week 3	Introduction to Supervised and Unsupervised Learning in Laboratory Data	Read about supervised and unsupervised learning techniques
Week 4	Neural Networks: Fundamentals and Application in Lab Science	Study the basics of neural networks and their use in laboratory tasks
Week 5	Deep Learning: Advanced Techniques and Uses in Laboratory Sciences	Review deep learning methods and applications in laboratory settings
Week 6	Natural Language Processing (NLP) for Laboratory Text Data	Read on how NLP is applied to research papers and lab data

Week 7	Text Mining and Data Extraction using NLP in Lab Sciences	Study the role of text mining in extracting data from scientific texts
Week 8	AI-Enhanced Diagnostics: AI applications in clinical and lab diagnostics	Prepare a report on AI-enhanced diagnostics and decision support
Week 9	AI in Decision Support Systems for Lab Applications	Study AI decision support tools used in laboratory environments
Week 10	AI in Image Analysis and Pattern Recognition: Applications in Lab Science	Review AI tools for image analysis in laboratory research
Week 11	Advanced Image Processing: Techniques for Pattern Recognition	Study advanced AI techniques in image analysis and pattern recognition
Week 12	AI-Driven Automation in Laboratory Research and Workflow	Research AI applications in automating laboratory tasks
Week 13	Robotics and AI for Lab Automation: Improving Efficiency	Prepare a report on the use of AI-driven robotics in laboratory work
Week 14	Practical Applications of AI in Lab Research: Case Studies and Real-World Examples	Study case studies on the practical implementation of AI in labs
Week 15	Challenges and Ethical Considerations in AI-Driven Lab Research	Review ethical issues and challenges related to AI in laboratory settings
Week 16	Review and Practical Applications of AI Tools in Laboratory Sciences	Revise key concepts and prepare for the final practical assessment

Textbooks and Reading Material

- Russell, S., & Norvig, P. (2020). Artificial Intelligence: A Modern Approach. Pearson.
- Compeau, P., & Pevzner, P. (2019). Bioinformatics Algorithms: An Active Learning Approach. Active Learning Publishing.
- Artificial Intelligence in Healthcare (2nd Edition, 2023) by Parashar Shah, Daniel J. Sussman - Covers AI applications in healthcare and laboratory settings.
- Introduction to Artificial Intelligence: A Guide for Scientists and Engineers (2021) by Wolfgang Ertel - A comprehensive guide to AI techniques for scientific research.
- Deep Learning for Biomedical Applications (2022) by N. M. R. Reddy - Focuses on deep learning models and their use in biomedical research.
- Machine Learning for Biomedical Applications (2020) by Kevin L. Smith - Provides insights into machine learning tools and techniques for lab sciences.
- Practical Machine Learning for Data Analysis Using Python (2023) by Nathan Yau - A practical guide to applying machine learning techniques in data analysis.

Teaching Learning Strategies

1. **Interactive Lectures**
   Engage students with interactive presentations, discussions, and real-time corrections of writing and speaking errors.
2. **Collaborative Learning**
   Students will work in pairs or small groups to write essays, analyze readings, and give peer feedback on presentations.
3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-404	Credit Hours	3 (3+0)
Course Title	QC/QA Management				

Course Introduction

The **QC/QA Management** course provides an in-depth understanding of quality control (QC) and quality assurance (QA) principles, practices, and standards in healthcare and laboratory settings. Students will learn how to implement and manage QC/QA systems to ensure the accuracy, reliability, and safety of medical tests, procedures, and patient care.

Learning Outcomes

On the completion of the course, the students will:

- Understand the fundamental principles of QC and QA in healthcare and laboratory environments.
- Apply QC/QA tools and techniques to improve the accuracy and reliability of laboratory results.
- Develop skills in designing and implementing quality control systems in medical and laboratory practices.
- Analyze and interpret QC/QA data to identify areas for improvement and ensure compliance with standards.
- Evaluate the role of QC/QA in enhancing patient safety and healthcare outcomes.

Course Content (Theory)		Assignments/Readings
Week 1	Introduction to Quality Management: Overview of quality management systems in healthcare and laboratory settings	Read: Introduction to Quality Management
	Quality Assurance in the Medical Laboratory: Importance and implementation in lab settings	Review standards for QA in medical laboratories
	Personnel Qualifications and Proficiency Testing: Ensuring qualified personnel and proficiency testing methods	Study requirements for laboratory staff qualifications
Week 2	Quality Improvement and Effective QA Programs: Strategies for continuous improvement in laboratory quality	Read about quality improvement strategies in laboratory environments
	Internal and External Quality Controls: Types and applications of internal and external controls	Review different types of quality control systems
	Spectrophotometry for QC: Role of spectrophotometry in quality control	Study spectrophotometry and its role in QC
Week 3	QC Terminology: Key terms used in quality control systems and their relevance in laboratory practice	Study common QC terminology and concepts
	Quality Control Concepts: Principles and practices of QC in lab sciences	Review quality control concepts and their application in labs
	Random Error, Standard Deviation (SD), and Spread of Data: Understanding variability in laboratory results	Read on statistical concepts related to QC (SD, variance, etc.)
Week 4	Calculation of Variance and Standard Deviation: Methods to calculate and interpret variance and SD	Solve exercises on calculating variance and standard deviation
	Coefficient of Variation and Its Calculation: Using CV to evaluate lab test consistency	Study the coefficient of variation and its calculation in lab tests
	Analyzing Quality Control Results: Techniques to analyze QC results and detect issues	Review methods for analyzing QC data
Week 5	Out-of-Range Results Management: Steps to manage and investigate out-of-range results	Read case studies on managing out-of-range results
	Sequential Steps for Out-of-Range Controls: Methods for handling out-of-range QC results	Study the sequential steps for handling QC results
	Rejection and Acceptance of Tests/Controls: Criteria for test acceptance and rejection	Review rejection criteria for laboratory tests and controls
Week 6	Precision, Reproducibility, and Accuracy: Understanding	Study the differences between

	the differences and importance of each concept	precision, reproducibility, and accuracy
	Normal Reference Ranges and Associated Problems: Understanding reference ranges and related issues	Read about the challenges in defining normal reference ranges
	Erroneous Samples: Causes and solutions to sample-related errors	Review types of erroneous samples and their impact on results
Week 7	Effects of Position on Laboratory Values: How the position of samples can affect lab results	Study the effects of sample positioning on test outcomes
	Factors Affecting Laboratory Values: Examining pre-analytical, analytical, and post-analytical factors	Prepare notes on factors that influence laboratory values
	Categories of Errors: Pre-analytical, Analytical, Post-analytical Errors	Study error categories in laboratory testing
Week 8	Interpretation of Results: Distinguishing between clinical and statistical significance	Review case studies on interpreting clinical and statistical results
	Specificity and Sensitivity: Understanding and calculating specificity and sensitivity in tests	Study specificity and sensitivity in diagnostic tests
	Efficiency in Laboratory Testing: Enhancing lab efficiency through proper QC/QA practices	Read about improving lab efficiency through quality management
Week 9	Reporting of Results: Best practices for accurate and timely result reporting	Prepare a report on result reporting procedures
	Computer Processes in the Clinical Laboratory: Role of computer systems in lab testing	Study the role of computers in lab result management
	Central Computer Memory in Clinical Labs: Understanding how data is processed and stored in lab systems	Read about data management in clinical laboratories
Week 10	Software for Mechanical Functions and Result Calculation: Lab software used for test automation	Study software tools used in laboratory for result calculations
	Administrative Functions in Clinical Laboratories: Administrative responsibilities in QA/QC management	Review administrative functions in laboratory quality management
	Personnel Tasks Related to QA/QC: Responsibilities of staff in maintaining quality standards	Study personnel roles in ensuring quality standards in labs
Week 11	Document Preparation for ISO and Other Quality Institutions: Understanding ISO documentation requirements	Read about ISO certification and the documentation process
	ISO Standards for Laboratory Quality Management: In-depth study of ISO quality standards	Study ISO 9001 and other relevant ISO standards
	Regulatory Compliance in Laboratory Testing: Understanding regulatory standards for QA/QC compliance	Review regulatory standards in laboratory testing and QA/QC
Week 12	Internal Audits in Quality Control Systems: Conducting internal audits and assessments in laboratory settings	Prepare an internal audit checklist for a laboratory
	External Quality Audits and Certification: Role of external audits in ensuring compliance with QA/QC standards	Study the process of external quality audits and certification
	Root Cause Analysis for QC Problems: Investigating and addressing underlying causes of quality issues	Read case studies on root cause analysis in QC systems
Week 13	Corrective and Preventive Actions (CAPA): Implementing corrective actions to resolve QC issues	Study the CAPA process and its application in laboratories
	Quality Metrics and KPIs for Laboratory Management: Using metrics to measure and improve laboratory quality	Review key performance indicators (KPIs) used in lab management
	Benchmarking for Laboratory Performance: Comparing laboratory performance with industry standards	Prepare a benchmarking report for a laboratory
Week 14	Continuous Quality Improvement (CQI): Approaches for sustaining quality improvement in laboratory settings	Study continuous quality improvement tools and methods

	Laboratory Safety and Quality: Integrating safety protocols into quality control systems	Review safety protocols and their integration into QC systems
	Ethical Considerations in Quality Management: Ensuring ethical standards in laboratory QC/QA	Read about ethical issues in laboratory quality management
Week 15	Document Control in QC Systems: Importance of document management and record-keeping in QC systems	Study document control processes and requirements in QC
	Validation of Laboratory Procedures: Ensuring that laboratory procedures meet quality standards	Read about validation processes for laboratory procedures
	Preparing for Laboratory Inspections: How to prepare for QA/QC inspections and audits	Review preparation materials for a lab inspection
Week 16	Technology in QC: Use of automated systems and software in laboratory quality control	Study the role of automation in QC and laboratory management
	Future Trends in Quality Control and Assurance: Emerging technologies and practices in QC/QA	Read on emerging trends in quality control and laboratory technologies
	Review of QC/QA Management Course: Summary of key principles and application of quality management in labs	Final exam preparation and review of all course topics

Textbooks and Reading Material

- **Quality Control in the Analytical Chemistry Laboratory (2023)** by James M. Butler - Focuses on quality control techniques and methodologies in laboratory settings.
- **Fundamentals of Quality Control and Improvement (4th Edition, 2021)** by Amitava Mitra - Covers the principles of quality control and improvement in various industries, including laboratories.
- **ISO 9001:2015 for Laboratories: A Practical Guide (2022)** by David Hoyle - A practical guide to implementing ISO 9001:2015 quality management systems in laboratory environments.
- **Laboratory Quality Management Systems: A Guide to Implementation (2020)** by C.G. Burns - A comprehensive guide to establishing and maintaining quality management systems in clinical laboratories.
- **Principles of Quality Control (2023)** by David W. Kellermann - An introduction to the principles of quality control and their application in laboratory testing and analysis.Crocker J, Burnett D, The Science of laboratory diagnosis. John Wiley & Sons; 2005.
- Bishop ML, Fody EP, Schoeff LE, editors. Clinical Chemistry: Principles, Techniques, and Correlations. Lippincott Williams & Wilkins; 2013 Feb

Teaching Learning Strategies

1. **Interactive Lectures**
   Engage students with interactive presentations, discussions, and real-time corrections of writing and speaking errors.
2. **Collaborative Learning**
   Students will work in pairs or small groups to write essays, analyze readings, and give peer feedback on presentations.
3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment			
Sr. No.	**Elements**	**Weightage**	**Details**
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%.
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-405	Credit Hours	3 (0+3)
Course Title	Internship				

Course Introduction

The **Internship** provides students with practical, hands-on experience in a real-world healthcare setting, focusing on various laboratory domains such as Clinical Microbiology, Clinical Hematology, Blood Bank, Clinical Chemistry, Histopathology, and Molecular Biology. This compulsory internship aims to bridge the gap between theoretical knowledge and practical application, preparing students for professional roles in the medical and healthcare laboratory sectors. The internship will involve exposure to laboratory techniques, equipment maintenance, quality control procedures, and patient sample analysis. Students will actively participate in lab operations, collaborate with healthcare professionals, and gain a comprehensive understanding of the day-to-day activities in clinical and diagnostic laboratories.

Learning Outcomes

On the completion of the Intership, the students will:

- **Apply Laboratory Skills:** Demonstrate proficiency in laboratory techniques, including culturing, staining, biochemical testing, and sample analysis across multiple laboratory disciplines.
- **Understand Quality Assurance (QA) & Quality Control (QC):** Implement and manage QA/QC protocols to ensure accuracy, reliability, and compliance with laboratory standards.
- **Operate Laboratory Equipment:** Use and maintain laboratory equipment, troubleshoot issues, and ensure proper calibration for optimal performance.
- **Interpret Results:** Analyze and interpret laboratory test results accurately, providing essential data for diagnosis and treatment.
- **Develop Professional Competencies:** Work effectively as part of a healthcare team, following ethical and safety guidelines, and communicate laboratory findings clearly to medical professionals.

Course Content (Theory)		Assignments/Readings
Week 1	**Clinical Microbiology:** Culturing Techniques, Media Preparation, and Types of Culture Media (Selective, Differential, Enriched)	Study the types of culture media and their applications in microbiology
	Clinical Microbiology: Culturing Techniques, Blood, MacConkey, Chocolate, Transport Media	Review procedures for preparing different types of culture media
	Clinical Microbiology: Biochemical Tests for Bacterial Identification (Catalase, Coagulase, Oxidase, TSI, Citrate)	Practice biochemical tests and their interpretation for bacterial ID
Week 2	**Clinical Microbiology:** Urine Routine Analysis and Fluids Analysis (Pus, Sputum, CSF) - Physical, Chemical, Microscopy	Study methods for analyzing urine and fluid samples in microbiology
	Clinical Microbiology: Sterilization Techniques (Heat, Radiation) and Disinfection Methods	Study sterilization and disinfection protocols used in microbiology
	Clinical Microbiology: Microscopy and Staining Techniques (Gram Staining, Zn Staining)	Perform and interpret Gram and Zn staining techniques
Week 3	**Clinical Hematology:** Lab Safety, Waste Management in Hematology	Review lab safety standards and waste management in hematology labs
	Clinical Hematology: Automation in Hematology, Maintenance, Quality Control, and Troubleshooting	Practice automation in hematology and trouble-shooting laboratory equipment
	Clinical Hematology: Total Leucocyte, RBC Count, Red Cell Indices, Eosinophil Count, Platelets Count	Perform blood cell counts and interpretation of results
Week 4	**Clinical Hematology:** Smear Preparation and Staining for Differential Diagnosis of Hematological Disorders	Prepare blood smears and practice differential counting

	Clinical Hematology: Reticulocyte Count, Hemoglobin Measurement, and ESR Analysis	Perform reticulocyte count and ESR testing in hematology
	Blood Bank: Quality Assurance & Control in Blood Bank Procedures	Study QA/QC procedures in blood bank operations
Week 5	**Blood Bank:** Blood Bags (Types, Storage & Preservatives)	Study the types of blood bags and their storage conditions
	Blood Bank: Blood Component Preparation and Separation Methods, 3-5% Red Cell Suspension Preparation	Perform blood component separation and prepare RBC suspensions
	Blood Bank: ABO Blood Grouping and Rh Typing	Practice ABO blood grouping and Rh typing methods
Week 6	**Blood Bank:** Cross Matching and Antiglobulin Test (Direct & Indirect)	Perform cross matching and antiglobulin tests
	Blood Bank: Rh Antibody Titration and Storage of Blood Components	Perform Rh antibody titration and study blood storage conditions
	Blood Bank: Clinical Antibody Identification and Interpretation	Practice identification of clinically important antibodies
Week 7	**Blood Bank:** Automation in Blood Bank and Troubleshooting	Practice using automated systems and troubleshoot common issues
	Clinical Chemistry: Compliance with QA/QC Procedures in Clinical Chemistry	Study compliance with QA/QC protocols in clinical chemistry
	Clinical Chemistry: Automation in Clinical Chemistry: Principles and Troubleshooting	Practice using automated systems in clinical chemistry and troubleshooting
Week 8	**Clinical Chemistry:** Maintenance of Laboratory Equipment (Pipets, pH Meters, Spectrophotometers, etc.)	Perform maintenance tasks on laboratory instruments
	Clinical Chemistry: Generation and Maintenance of Inventory Lists for Smooth Lab Operations	Study and create inventories for lab operations
	Histopathology: Labeling and Preparation of Specimens	Practice proper specimen labeling and preparation for histopathological analysis
Week 9	**Histopathology:** Care and Cleaning of Microscopes, Fixation, Dehydration, and Clearing Techniques	Study and apply techniques for specimen fixation and microscope maintenance
	Histopathology: Microtome Operation and Maintenance, Tissue Freezing Techniques	Operate and maintain a microtome, practice freezing tissue for sectioning
	Histopathology: Routine Hematoxylin-Eosin Staining of Paraffin Sections	Perform H&E staining of paraffin-embedded tissue sections
Week 10	**Histopathology:** Special Stains: Sudan Black B, Best's Carmine, and Stains for Nervous Tissues	Perform special stains on tissue samples
	Histopathology: Staining for Frozen Sections and Specific Tissues (Calcium, Iron, Melanin, etc.)	Apply specific stains for frozen sections and special tissue types
	Histopathology: Biopsy Techniques: Types of Biopsies and Their Merits/Demerits	Study and perform biopsy preparation techniques
Week 11	**Histopathology:** Special Gross Anatomical Techniques, Preserving and Mounting Specimens	Learn and apply methods for anatomical specimen preservation and mounting
	Molecular Biology: Molecular Biology Reagents Preparation and Calculations	Prepare molecular biology reagents and perform calculations
	Molecular Biology: DNA Extraction from Bacteria and Blood Cells (Manual Methods and Kits)	Practice DNA extraction from various sources using manual methods and kits

Week 12	**Molecular Biology:** Agarose Gel Electrophoresis and DNA Quantification Using Spectrophotometer	Perform agarose gel electrophoresis and quantify DNA using spectrophotometry
	Molecular Biology: PCR Amplification (Principles, Procedures, Troubleshooting)	Perform PCR amplification and troubleshoot common problems
	Molecular Biology: SDS PAGE and Western Blotting Techniques	Practice SDS PAGE and Western blotting for protein analysis
Week 13	**Molecular Biology:** Real-Time PCR Techniques and DNA Sequencing Methods	Learn and apply real-time PCR and DNA sequencing techniques
	Molecular Biology: Chemical Sequencing of DNA and Troubleshooting	Perform chemical DNA sequencing and address common troubleshooting issues
	Molecular Biology: Troubleshooting in DNA Extraction and PCR Processes	Focus on troubleshooting techniques for DNA extraction and PCR
Week 14	**Molecular Biology:** Introduction to Genomic Research and Data Interpretation	Study the basics of genomic research and interpreting sequencing data
	Clinical Microbiology: Advanced Techniques in Bacterial Identification (Molecular Methods)	Practice molecular techniques for advanced bacterial identification
	Clinical Hematology: Advanced Hematology Techniques (Flow Cytometry, Bone Marrow Biopsy)	Study and practice advanced techniques used in hematology labs
Week 15	**Blood Bank:** Advanced Techniques in Blood Typing and Antibody Identification	Practice advanced blood typing and antibody identification techniques
	Clinical Chemistry: Analysis of Enzyme Activities and Biochemical Markers	Perform assays for enzyme activity and biochemical markers
	Histopathology: Special Stains for Infection and Inflammatory Diseases	Apply specialized stains for detecting infections and inflammation
Week 16	**Molecular Biology:** Practical Applications of CRISPR in Molecular Biology	Explore CRISPR technology and its application in molecular research
	Clinical Chemistry: Application of Quality Control in Clinical Chemistry Tests	Study quality control measures for clinical chemistry tests
	Review Week: Recap of all major techniques across domains (Microbiology, Hematology, Blood Bank, etc.)	Review all practical sessions and finalize any pending assignments

Teaching Learning Strategies

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   Engage students with interactive presentations, discussions, and real-time corrections of writing and speaking errors.
2. **Collaborative Learning**
   Students will work in pairs or small groups to write essays, analyze readings, and give peer feedback on presentations.
3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II

3. Presentation 4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%.
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-406	Credit Hours	3(2+1)
Course Title	Advanced Molecular Biology				

Course Introduction

This course integrates concepts from biology, chemistry, genetics, and biochemistry at the molecular level. It focuses on understanding how various cellular systems interact, particularly in relation to DNA, RNA, and protein synthesis. Molecular biology techniques, which are intrinsic to the field, are also combined with methods from genetics and biochemistry. A key component of the course is bioinformatics—the collection, classification, storage, and analysis of biochemical and biological data, especially as applied to molecular genetics and genomics, using computational tools. The course covers genetic transfer mechanisms in bacteria, genome organization, molecular biological techniques, and molecular diagnostic procedures and applications. Additionally, students will learn to manage and analyze biological data using specialized software and computational tools in molecular biology.

Learning Outcomes

On the completion of the course, the students will:

- **Understand Cellular Interactions:** Explain the interactions between DNA, RNA, and proteins within cellular systems, focusing on their roles in gene expression and protein synthesis.
- **Apply Molecular Biology Techniques:** Utilize key molecular biology techniques, including PCR, gel electrophoresis, DNA/RNA extraction, and sequencing for various applications in genetics and biochemistry.
- **Perform Bioinformatics Analysis:** Use bioinformatics tools and software to collect, classify, store, and analyze biological and biochemical data, with an emphasis on genomics and molecular genetics.
- **Understand Genetic Transfer and Genome Organization:** Comprehend mechanisms of genetic transfer in bacteria, genome structure and organization, and the principles behind molecular genetic techniques.
- **Integrate Molecular Diagnostics:** Apply molecular biology techniques in diagnostics, including genetic testing and pathogen detection, and understand their relevance in clinical and research settings.
- **Manage Biological Data Using Technology:** Use computational tools and software to manage, analyze, and interpret large-scale biological datasets, and apply these tools to real-world molecular biology problems.

Course Content (Theory)		Assignments/Readings
Week 1	Introduction to Bacterial Genetics: Gene transfer mechanisms in bacteria	Reading: Chapter on Gene Transfer Mechanisms
	Transformation, Transduction, and Conjugation of Bacterial DNA	Assignment: Study of bacterial transformation in lab
Week 2	Mitochondrial DNA, Genome Organization, Human Genome Project Overview	Reading: Articles on Mitochondrial DNA and Human Genome Project
	Introduction to Polymerase Chain Reaction (PCR): History, Principle, Procedure	Assignment: Write a summary of PCR history and applications
Week 3	PCR Reagent Preparation & Primer Designing	Practical: Design primers for a sample PCR reaction
	PCR Optimization & Troubleshooting	Reading: Common PCR issues and troubleshooting methods
Week 4	Different Types of PCR: Nested PCR, Multiplex PCR	Assignment: Create a diagram of Nested vs. Multiplex PCR
	Allele-Specific PCR & ARMS PCR	Practical: Perform Allele-Specific PCR in the lab
Week 5	Real-Time PCR: Principles, Isolation of cDNA, Primer & Probe Designing	Reading: Real-Time PCR Applications
	Real-Time PCR Fluorescent Dyes, Nested RT-PCR	Assignment: Design a primer-probe pair for RT-PCR

Week 6	Real-Time PCR Quantification & Applications	Practical: Perform Real-Time PCR and analyze data
	Restriction Enzymes: History, Nomenclature, Restriction-Modification System	Reading: Overview of Restriction Enzymes and their applications
Week 7	Applications of Restriction Enzymes in Molecular Biology	Assignment: Prepare a report on the use of restriction enzymes in cloning
	Restriction Fragment Length Polymorphism (RFLP-PCR), Restriction Mapping	Practical: Perform an RFLP-PCR analysis
Week 8	DNA Sequencing: Sanger Method, Maxam-Gilbert Method	Reading: DNA sequencing techniques and comparison
	Denaturing Gel Electrophoresis for Sequencing	Practical: Analyze sequencing results using denaturing gels
Week 9	Next Generation Sequencing (NGS) Overview	Assignment: Research paper on NGS technologies
	Emerging Sequencing Techniques	Reading: Latest trends in sequencing technologies
Week 10	DNA Libraries & Gene Mapping Techniques	Assignment: Study on creation and application of DNA libraries
	Gene Mapping, Linkage Analysis	Practical: Perform a gene mapping exercise
Week 11	Introduction to Recombinant DNA Technology: History and Basic Concepts	Reading: Chapter on Recombinant DNA Technology
	Vectors and Cloning: Types and Functions	Assignment: Create a diagram illustrating vector types
Week 12	Recombinant DNA Cloning Techniques	Practical: Perform a cloning experiment using plasmids
	Bioinformatics: Introduction, Glossary, Biological Databases	Reading: Overview of bioinformatics databases
Week 13	Data Annotation, Redundancy, NCBI, GenBank, EBI, DDBJ	Assignment: Research the NCBI database and its applications
	Gene Data Annotation in Bioinformatics	Practical: Annotate a gene sequence using NCBI tools
Week 14	Introduction to Bioinformatics Tools	Assignment: Familiarization with bioinformatics software tools
	Bioinformatics and Next-Generation Sequencing Data	Reading: Articles on bioinformatics applications in NGS
Week 15	Analysis of Genomic Data Using Bioinformatics Tools	Practical: Analyze NGS data using bioinformatics tools
	Applications of Molecular Biology in Medical Diagnostics	Assignment: Write a case study on the use of molecular biology in diagnostics
Week 16	Molecular Biology in Biotechnology & Personalized Medicine	Reading: Explore applications in personalized medicine
	Review of Advanced Molecular Biology Techniques & Future Trends	Assignment: Final exam preparation and review
Course Content (Lab)		**Assignments/Readings**
Week 1	Molecular Biology Reagents' Preparation and Calculations	Reading: Overview of reagent preparation techniques
Week 2	Genomic DNA Extraction from Bacteria (Manual Method)	Practical: Perform DNA extraction from bacterial culture
Week 3	Genomic DNA Extraction from Bacteria (Kit Method)	Assignment: Compare manual vs. kit methods for DNA extraction

Week 4	Genomic DNA Extraction from Blood Cells (Manual Method)	Practical: Extract genomic DNA from human blood samples
Week 5	Genomic DNA Extraction from Blood Cells (Kit Method)	Assignment: Write a comparison report on manual vs. kit DNA extraction from blood
Week 6	Agarose Gel Electrophoresis: Principles and Application	Practical: Run DNA samples on agarose gel and visualize results
Week 7	Plasmid DNA Extraction (Manual Method)	Practical: Extract plasmid DNA from bacterial culture manually
Week 8	Plasmid DNA Extraction (Kit Method)	Assignment: Perform plasmid DNA extraction using a kit and compare efficiency
Week 9	RNA Extraction from Bacteria (Manual Method)	Practical: Extract RNA from bacterial cells using manual method
Week 10	RNA Extraction from Bacteria (Kit Method)	Assignment: Compare manual vs. kit RNA extraction methods
Week 11	RNA Extraction from Blood Cells (Manual Method)	Practical: Extract RNA from blood cells using manual method
Week 12	RNA Extraction from Blood Cells (Kit Method)	Assignment: Write a report comparing RNA extraction methods from blood cells
Week 13	DNA Quantification by Spectrophotometer	Practical: Measure the concentration and purity of DNA using a spectrophotometer
Week 14	RNA Quantification by Spectrophotometer	Practical: Measure the concentration and purity of RNA using a spectrophotometer
Week 15	Practical Review: DNA and RNA Quantification Techniques	Assignment: Review and submit lab report on DNA and RNA quantification
Week 16	Final Practical Examination & Lab Review	Final practical exam on all lab techniques performed throughout the course

Textbooks and Reading Material

- Demir, K., & Görgün, S. (2021). Human Autoimmunity and Associated Diseases. Cambridge Scholars Publishing. Sarma, P. V. (2019). Molecular Biology: A Practical Manual. MJP Publisher.
- Weaver, R. F. (2020). Molecular Biology (6th ed.). McGraw-Hill Education.
- Pakistan Academy of Sciences. (2019). Handbook for Good Clinical Laboratory Practices in Pakistan.
- Karp, G., Iwasa, J., & Marshall, W. (2020). Karp's Cell and Molecular Biology. John Wiley & Sons.
- Brown, T. A. (2018). Gene Cloning and DNA Analysis: An Introduction (7th ed.). Wiley.
- Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2018). Molecular Biology of the Cell (6th ed.). Garland Science.

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   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

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2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

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3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-407	Credit Hours	3(2+1)
Course Title	Advanced Clinical Microbiology				

Course Introduction

The course will focus on the clinical significance of bacteria that cause diseases in humans, covering their taxonomy and general characteristics. It will include a detailed study of Gram-positive cocci such as Staphylococci and Streptococci, along with Enterococci. The course will also examine Enterobacteriaceae, non-fermentative Gram-negative bacilli, curved Gram-negative bacilli, and Dysgonomonas species. Additionally, it will provide insight into viral and fungal diseases. The interactions between microbes, hosts, and the environment will be explored. Laboratory sessions will emphasize the isolation and identification of medically important bacteria, staining techniques, and media preparation.

Learning Outcomes

On the completion of the course, the students will:

- **Identify and Classify Pathogenic Microorganisms:** Accurately identify and classify Gram-positive and Gram-negative bacteria, including cocci, bacilli, and other medically significant microorganisms.
- **Understand Microbial Pathogenesis:** Describe the clinical significance and pathogenesis of various bacterial, viral, and fungal diseases in humans, focusing on mechanisms of infection and disease progression.
- **Apply Laboratory Techniques:** Demonstrate proficiency in isolating and identifying medically important bacteria using various laboratory techniques, including staining methods and media preparation.
- **Interpret Microbial Interactions:** Explain the interactions between microorganisms, human hosts, and the environment, emphasizing microbial growth, survival, and pathogenicity.
- **Use Staining and Culture Techniques:** Utilize appropriate staining techniques (e.g., Gram stain, acid-fast stain) and culture media for the isolation and identification of pathogens in clinical samples.

Course Content (Theory)		Assignments/Readings
Week 1	Classification of Microbes	Read: Overview of microbial classification (Prokaryotes & Eukaryotes)
	Prokaryotes vs Eukaryotes; Bacterial Growth and Replication	Study: Differences between prokaryotic and eukaryotic cells
Week 2	Sterilization & Disinfection Techniques	Assignment: Compare various sterilization methods used in clinical microbiology
	Bacterial Genetics	Read: Mechanisms of bacterial gene transfer (Transformation, Transduction, Conjugation)
Week 3	General Mechanisms of Bacterial Pathogenesis	Assignment: Discuss bacterial virulence factors and pathogenesis
	Normal Flora and Its Role in Human Health	Read: Role of normal flora in immunity and health
Week 4	Antimicrobial Sensitivity Testing Techniques	Practical: Perform antimicrobial susceptibility testing (disk diffusion method)
	Quality Assurance in Microbiology Laboratory	Read: Principles of quality control and assurance in microbiological labs
Week 5	Microscopy in Microbiological Diagnostics	Practical: Use microscopy to identify bacterial shapes and structures
	Staining Methods (Gram Stain, Acid-fast Stain)	Practical: Perform Gram stain and other common microbiological stains

Week 6	Culture Media and Their Preparation	Practical: Prepare various types of culture media for bacterial isolation
	Methods for Anaerobic Culture	Practical: Set up anaerobic cultures using different techniques
Week 7	Common Culture Methods in Microbiology	Read: Overview of streak plate, pour plate, and spread plate methods
	Serological Techniques in Microbiology	Practical: Perform serological tests to identify antigens and antibodies
Week 8	Collection, Transport & Processing of Microbiological Specimens	Assignment: Best practices for specimen collection and transport
	Biochemical Testing of Microorganisms	Practical: Perform biochemical tests (e.g., catalase, oxidase, TSI) to identify bacteria
Week 9	Introduction to Parasitology and Parasite Classification	Read: Overview of parasitology and classification of medically important parasites
	Medically Important Parasites: *Entamoeba histolytica*	Study: Clinical presentation and laboratory diagnosis of *Entamoeba histolytica*
Week 10	Medically Important Parasites: *Naegleria* species	Read: Discuss clinical significance of *Naegleria* and diagnostic methods
	Medically Important Parasites: *Giardia lamblia*	Assignment: Case study on *Giardia lamblia* infection and diagnosis
Week 11	Lower Respiratory Tract Infections (Pneumonia, Tuberculosis)	Read: Pneumonia and tuberculosis: Diagnosis and treatment
	Upper Respiratory Tract Infections (*Haemophilus influenzae*, *Mycoplasma pneumoniae*, *Streptococcus pneumoniae*)	Assignment: Review pathogens and treatment of upper respiratory infections
Week 12	Sexually Transmitted Infections (Gonorrhoea, Chlamydia, Syphilis)	Read: Epidemiology and treatment of STIs
	Gastrointestinal Infections: *Clostridium difficile*	Assignment: Discuss the pathogenesis and clinical significance of *Clostridium difficile*
Week 13	Introduction to Virology: Virus Structure & Classification	Read: Structure, replication, and classification of viruses
	Viral Replication Mechanisms	Study: Overview of viral replication and the impact on clinical diagnosis
Week 14	Hepatitis Viruses (A, B, C, D, E)	Assignment: Clinical manifestations and diagnostic methods for hepatitis
	HIV and Its Clinical Manifestations	Read: HIV pathogenesis and diagnostic techniques
Week 15	Influenza Virus: Clinical Features and Diagnosis	Study: Influenza virus types, transmission, and prevention
	Mumps and Measles Viruses: Clinical Features and Diagnosis	Assignment: Case study of mumps and measles viral infections
Week 16	Rabies and Dengue Viruses: Diagnosis and Management	Read: Rabies and dengue virus pathophysiology and diagnostic tests
	Mycology: General Properties and Classification of Fungi	Read: Classification of medically important fungi and their

		significance
Course Content (Lab)		**Assignments/Readings**
Week 1	Collection and transportation of clinical samples	Reading: Introduction to Clinical Microbiology; (Sample Collection Techniques)
Week 2	Microscopic examination of clinical samples	Assignment: Prepare a report on the different types of microscopy used in clinical microbiology
Week 3	Infections of the ear, nose, and throat (Swabs)	Reading: (Infections of the Upper Respiratory Tract)
Week 4	Infections of the eye	Assignment: Case study on ocular infections and their microbial causes
Week 5	Infections of the gastrointestinal tract (GIT)	Reading: (Gastrointestinal Infections)
Week 6	Infections of the urogenital tract (Swabs)	Assignment: Review of common pathogens in urogenital infections
Week 7	Isolation and identification of selected microorganisms	Reading: (Microbial Isolation and Identification)
Week 8	Media preparation (McConkey Agar)	Lab Practice: Prepare McConkey Agar and observe bacterial growth
Week 9	Streaking techniques	Assignment: Write up of streak plate method and its applications
Week 10	Streaking and simple staining (Crystal Violet)	Reading: (Staining Techniques)
Week 11	Gram staining	Lab Practice: Perform Gram staining and report results
Week 12	ZN staining with microscopy	Reading: (Acid-Fast Staining and Mycobacterial Infections)
Week 13	Observation of fungal cells	Assignment: Identify common fungal infections under the microscope
Week 14	Urine analysis	Reading: (Urinary Tract Infections)
Week 15	Urine culture and interpretation	Lab Practice: Perform urine culture and analyze results
Week 16	Review and integration of all techniques	Final Report: Summarize key microbiological techniques and their clinical applications
Textbooks and Reading Material		
• Medical Microbiology by Patrick R. Murray, Ken S. Rosenthal, and Michael A. Pfaller – Comprehensive coverage of clinical microbiology and diagnostics. • Clinical Microbiology Made Ridiculously Simple by Mark Gladwin and William Trattler – A simplified, practical guide to clinical microbiology concepts. • Clinical Microbiology by Mackie & McCartney – Essential text for understanding the principles of microbiology in a clinical context. • Microbiology: A Clinical Approach by Stephen A. S. – Updated content focusing on clinical applications and diagnostic techniques. • Diagnostic Microbiology and Infectious Disease by James Versalovic – Detailed guide to diagnostic methods and infectious diseases.		
Teaching Learning Strategies		

1. **Interactive Lectures**
   Engage students with interactive presentations, discussions, and real-time corrections of writing and speaking errors.
2. **Collaborative Learning**
   Students will work in pairs or small groups to write essays, analyze readings, and give peer feedback on presentations.
3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-408	Credit Hours	3(2+1)
Course Title	Advanced Clinical Biochemistry				

Course Introduction

Chemical pathology focuses on the biochemical analysis of bodily fluids like blood, urine, and cerebrospinal fluid. By examining changes in the body's chemical composition, diseases can be diagnosed, monitored, and tracked over time. These biochemical changes can result from various factors, and the field is continually evolving with recent advancements in chemical pathology.

Learning Outcomes

On the completion of the course, the students will:

- **Understand the Principles of Chemical Pathology**: Comprehend the role of biochemical analysis in diagnosing and monitoring diseases through the examination of bodily fluids.
- **Identify Biochemical Changes**: Recognize and interpret changes in the chemical composition of blood, urine, and cerebrospinal fluid related to various diseases and physiological conditions.
- **Apply Diagnostic Techniques**: Demonstrate proficiency in performing biochemical tests and interpreting results to assist in the diagnosis and monitoring of diseases.
- **Evaluate Disease Mechanisms**: Understand how biochemical changes correlate with disease processes and how these changes can aid in clinical decision-making.
- **Stay Updated with Advancements**: Analyze recent advancements in chemical pathology and understand their impact on disease diagnosis and management.
- **Critical Thinking and Problem Solving**: Develop the ability to critically assess biochemical data, identify abnormal results, and suggest appropriate diagnostic and therapeutic actions.
- **Improve Patient Care**: Use chemical pathology knowledge to contribute to effective patient care by assisting in the diagnosis, prognosis, and management of various conditions.

Course Content (Theory)		Assignments/Readings
Week 1	**Liver Function**: Biochemical Functions of the Liver	Reading: Clinical Biochemistry: Metabolic and Clinical Aspects (Chapter on Liver Functions); Assignment: Review article on liver's metabolic roles
	Liver Function: Lab Diagnosis and Interpretation of Liver Function Tests	Reading: Clinical Laboratory Diagnostics (Liver Tests); Assignment: Case study on liver function test interpretation
Week 2	**Liver Function**: Methods of Determination of Serum Bilirubin	Reading: Research papers on bilirubin measurement techniques; Assignment: Practical on serum bilirubin determination
	Liver Function: Methods of Determination of Liver Enzymes, Method Interferences	Reading: Methods in Clinical Chemistry (Liver Enzymes); Assignment: Review article on enzyme determination methods
Week 3	**Renal Function Tests**: Blood Urea Nitrogen (BUN), Serum Urea	Reading: Renal Function and Metabolism (BUN & Urea); Assignment: Case problems related to urea levels
	Renal Function Tests: Phenolsulfonaphthalein (PSP) Test, Serum Creatinine	Reading: Biochemistry of Renal Function (PSP & Creatinine); Assignment: Lab exercise on PSP and creatinine clearance

Week 4	**Renal Function Tests**: Creatinine Clearance, Serum Uric Acid	Reading: Laboratory Diagnosis in Clinical Biochemistry (Renal Tests); Assignment: Review article on creatinine and uric acid
	Lipid Profile: Cholesterol, Triglycerides	Reading: Lipid Metabolism and Clinical Biochemistry (Cholesterol & Triglycerides); Assignment: Case study on lipid disorders
Week 5	**Lipid Profile**: HDL, LDL, VLDL	Reading: Biochemistry of Lipids (HDL, LDL, VLDL); Assignment: Write-up on clinical significance of lipoproteins
	Role of Enzymes in Clinical Laboratory: Cardiac Profile	Reading: Cardiac Biomarkers in Clinical Diagnostics (Cardiac Enzymes); Assignment: Presentation on cardiac enzymes
Week 6	**Cardiac Profile**: Cardiac Proteins - Myoglobin, Troponin-I, Troponin-T	Reading: Research articles on cardiac biomarkers; Assignment: Case analysis with cardiac biomarkers
	Cardiac Profile: Cardiac Enzymes - CKBB, LDH	Reading: Clinical Enzymology (Cardiac Enzymes); Assignment: Case study on CKBB and LDH levels
Week 7	**Pathology Biomarkers**: Pathogenesis of Bone Disorders (Osteoporosis, Paget's Disease)	Reading: Bone and Mineral Metabolism (Osteoporosis & Paget's); Assignment: Write-up on osteoporosis and Paget's disease
	Pathology Biomarkers: Genetic Abnormalities	Reading: Molecular Genetics in Clinical Biochemistry; Assignment: Case analysis on genetic biomarkers
Week 8	**Electrolytes Imbalance**: Sodium, Potassium, Chloride, Bicarbonate	Reading: Clinical Electrolyte Disorders (Electrolyte Imbalances); Assignment: Solve case studies on electrolyte imbalances
	Electrolytes Imbalance: Ca, pH, Mg	Reading: Laboratory Diagnosis of Acid-Base Disorders; Assignment: Practical lab on electrolyte measurements
Week 9	**Electrolytes Imbalance**: Methods of Determination of Electrolytes	Reading: Methods in Clinical Chemistry (Electrolyte Assays); Assignment: Review paper on electrolyte measurement techniques
	Electrolytes Imbalance: Principles of Methods for Determination of Blood Gases and pH	Reading: Blood Gases and Acid-Base Balance; Assignment: Practical exercise on blood gas analysis
Week 10	**Plasma Proteins**: Names of Plasma Proteins, Methods of Determination of Proteins	Reading: Plasma Proteins and Clinical Laboratory Analysis; Assignment: Write-up on the role of plasma proteins
	Plasma Proteins: Protein Electrophoresis	Reading: Electrophoresis Techniques in Clinical Chemistry; Assignment: Lab work on protein

		electrophoresis
Week 11	**General Endocrine Functions and Pathological Conditions**: Pituitary Gland - Anterior and Posterior Pituitary Hormones	Reading: Endocrine Physiology (Pituitary Functions); Assignment: Case study on pituitary disorders
	General Endocrine Functions and Pathological Conditions: Hypothalamic Hormones, Positive and Negative Feedback Mechanism	Reading: Hypothalamic Regulation of Endocrine Function; Assignment: Essay on feedback mechanisms in endocrine regulation
Week 12	**Thyroid Functions and Associated Disorders**: Thyroid Profile - T3, T4, TSH	Reading: Thyroid Disorders and Diagnosis (Thyroid Function Tests); Assignment: Review article on thyroid function tests
	Thyroid Functions and Associated Disorders: Hyperthyroidism, Hypothyroidism	Reading: Thyroid Disease: Diagnosis and Treatment; Assignment: Case study on hypothyroidism and hyperthyroidism
Week 13	**Parathyroid Hormones**: Parathyroid Gland Functions and Associated Disorders	Reading: Parathyroid Hormones in Clinical Disorders; Assignment: Literature review on PTH and calcium regulation
	Parathyroid Hormones: Effects of PTH on Ca and Ph	Reading: Calcium and Phosphate Metabolism; Assignment: Solve clinical cases on calcium-phosphate imbalance
Week 14	**Male and Female Sex Hormones**: Synthesis, Secretion, Actions, and Metabolism	Reading: Sex Hormones in Health and Disease; Assignment: Write-up on hormonal regulation of reproduction
	Male and Female Sex Hormones: Amenorrhea, Oligomenorrhoea, Hirsutism, Virilism	Reading: Endocrine Causes of Reproductive Disorders; Assignment: Case analysis on reproductive endocrinopathies
Week 15	**Male and Female Sex Hormones**: Spermatogenesis, Ovulation, Climacteric	Reading: Endocrinology of Reproduction; Assignment: Presentation on hormonal control of spermatogenesis and ovulation
	Methods of Hormone Analysis: ELISA, Chemiluminescence	Reading: Techniques in Hormone Analysis; Assignment: Review article on hormone detection methods
Week 16	**Tumor Markers**	Reading: Tumor Markers in Cancer Diagnosis; Assignment: Case study on tumor markers in cancer diagnostics
	Adrenal Glands: Hormones of the Adrenal Medulla and Cortex, Hypo- and Hypersecretion, Cushing's Syndrome, Addison's Disease, Pheochromocytoma	Reading: Adrenal Disorders and Endocrinology; Assignment: Case study on adrenal gland disorders
Course Content (Lab)		**Assignments/Readings**
Week 1	Introduction to Clinical Biochemistry and Blood Analytical Procedures	Read Chapters on Clinical Biochemistry Basics

Week 2	Creatinine and Fatty Acids Determination	Read article on Creatinine and Fatty Acids Analysis Methods
Week 3	Phosphates and Iron Determination	Review relevant research papers on phosphate and iron testing
Week 4	Plasma Protein and Calcium Determination	Study Plasma Protein Measurement Techniques
Week 5	Cholesterol and Glucose Determination	Review cholesterol metabolism and glucose homeostasis
Week 6	Urea Determination and Quantitative Analysis of Blood	Read Chapter on Urea and Blood Analysis Techniques
Week 7	Diabetic Profile: Glucose, Insulin, Glucagon, HbA1c, OGTT	Read on Diabetic Profiles and OGTT Procedures
Week 8	Cardiac Profile: Myoglobin, Troponin-I, Troponin-T, CPK, LDH, AST	Study Cardiac Markers and Their Clinical Relevance
Week 9	Pancreatic Function Tests: Amylase and Lipase	Read on Pancreatic Enzyme Functions in Diagnosis
Week 10	Thyroid Function Tests: T3, T4, TSH	Review Thyroid Hormone Regulation and Testing Methods
Week 11	Plasma Proteins Determination: Total Protein, Albumin, Globulin	Study Plasma Protein Profiles and Diagnostic Importance
Week 12	Principle and Methods of Blood Gas and pH Determination	Read on Blood Gas Analysis Techniques
Week 13	Methods of Hormone Analysis: ELISA	Review ELISA Techniques and Applications
Week 14	Methods of Hormone Analysis: Chemiluminescence	Study Chemiluminescence Methodology and Uses
Week 15	Review of All Clinical Biochemistry Techniques	Prepare for Practical Lab Exams
Week 16	Practical Lab Exam and Final Evaluation	Study Practical Lab Procedures for Final Exam

Textbooks and Reading Material

- Clinical Biochemistry: Metabolic and Clinical Aspects by William J. Marshall & Stephen K. Bangert
- Clinical Chemistry: Principles, Techniques, and Correlations by Michael L. Bishop, Edward P. Fody, Larry E. Schoeff
- Tietz Textbook of Clinical Chemistry and Molecular Diagnostics by Carl A. Burtis & David E. Bruns
- Clinical Biochemistry: An Illustrated Colour Text by J. S. P. Tan
- Biochemistry for the Medical Sciences by John W. Baynes & Marek H. Dominiczak

Teaching Learning Strategies

1. **Interactive Lectures**
   Engage students with interactive presentations, discussions, and real-time corrections of writing and speaking errors.
2. **Collaborative Learning**
   Students will work in pairs or small groups to write essays, analyze readings, and give peer feedback on presentations.
3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar			
1. Quiz-1 2. Quiz-II 3. Presentation, Professional Writing Assignments			
Assessment			
Sr. No.	**Elements**	**Weightage**	**Details**
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-409	Credit Hours	3(2+1)
Course Title	Advanced Clinical Histopathology				

Course Introduction

This **Advanced Clinical Histopathology** course is tailored for students with a solid foundation in basic histopathology, aiming to enhance their expertise in diagnostic histopathology. The course delves into advanced techniques, technologies, and methodologies used in clinical histopathology, with a strong focus on disease diagnosis and applications in research.

Learning Outcomes

On the completion of the course, the students will:

- **Demonstrate mastery** in advanced histopathological techniques, including tissue processing, staining, and microscopy.
- **Interpret histopathological slides** with a high degree of accuracy for diagnosing a wide range of diseases, including cancers and inflammatory disorders.
- **Apply advanced imaging technologies** (e.g., digital pathology, immunohistochemistry) in the analysis and diagnosis of pathological specimens.
- **Evaluate and correlate histopathological findings** with clinical presentations, laboratory results, and imaging studies.
- **Utilize molecular techniques** (e.g., PCR, in situ hybridization) to enhance diagnostic capabilities and understand disease mechanisms.
- **Critically assess current research** in clinical histopathology and integrate new methodologies into diagnostic practice.
- **Develop research proposals** for novel histopathological studies with a focus on disease diagnosis, prognosis, and treatment.
- **Communicate effectively** with clinical teams, explaining histopathological findings and their implications for patient care and treatment decisions.
- **Maintain ethical and professional standards** in handling, analyzing, and reporting histopathological data.

Course Content (Theory)		Assignments/Readings
Week 1	Introduction to Advanced Histopathological Techniques	Read Chapter on Histological Techniques and Overview
	Tissue Processing: Embedding and Sectioning	Review protocols for tissue embedding and sectioning methods
Week 2	Special Stains for Tissue Differentiation	Study the principles and applications of special stains in histopathology
	Advanced Microscopy Techniques	Read articles on the latest advancements in microscopy for tissue analysis
Week 3	Advanced Fixation Methods	Study different fixation techniques and their impact on tissue preservation
	Histopathology of Complex Diseases	Read case studies on complex diseases and their histopathological features
Week 4	Advanced Study of Neoplastic Lesions	Study the histopathology of neoplastic diseases, including benign and malignant tumors
	Inflammatory and Infectious Disease Histopathology	Review histopathology of inflammatory diseases and infections

Week 5	Advanced Diagnostic Challenges	Research challenges in diagnosing complex diseases through histopathology
	Case Studies in Complex Histopathology	Prepare for discussion on complex histopathology case studies
Week 6	Introduction to Molecular Diagnostics in Histopathology	Read on molecular diagnostics and their integration into histopathology
	Molecular Markers in Cancer Diagnosis	Study the use of molecular markers in cancer diagnosis
Week 7	Genetic Alterations in Disease	Review genetic alterations and their impact on disease progression
	Advanced Molecular Techniques	Read papers on advanced molecular diagnostic techniques used in histopathology
Week 8	Principles of Immunohistochemistry (IHC)	Study the principles and applications of IHC in disease diagnosis
	IHC Panel Design	Research the process of designing IHC panels for diagnostic purposes
Week 9	Special Stains for Specific Organs	Review organ-specific special stains and their diagnostic relevance
	Interpretation of IHC and Special Stains	Practice interpreting IHC results and special stains in case scenarios
Week 10	Histopathology in Medical Research	Read about the role of histopathology in advancing medical research
	Tissue Microarrays and High-Throughput Techniques	Study the use of tissue microarrays and high-throughput technologies in research
Week 11	Advanced Image Analysis in Histopathology	Explore advanced image analysis techniques used in histopathology
	Hands-on Research Projects	Conduct research-based projects and document findings in histopathology
Week 12	Role of Histopathology in Clinical Decision-Making	Review case studies where histopathology plays a key role in clinical decisions
	Interdisciplinary Communication and Consultation	Study effective communication strategies in multidisciplinary teams
Week 13	Participation in Tumor Boards and Case Discussions	Prepare for participation in tumor boards and case discussion sessions
	Collaboration with Laboratory Professionals	Explore the collaborative role of histopathologists in diagnostic laboratories
Week 14	Ethical Issues in Histopathology Practice	Review ethical challenges in histopathology, including patient confidentiality
	Patient Confidentiality and Informed Consent	Study guidelines for maintaining patient confidentiality and informed consent
Week 15	Quality Control and Assurance in the Laboratory	Learn about quality assurance practices and their importance in histopathology labs

	Regulatory Compliance and Accreditation	Study the regulatory standards and accreditation processes for histopathology laboratories
Week 16	Review of Key Topics and Case Discussions	Prepare for a comprehensive review of all course topics
	Final Assessment and Course Wrap-Up	Complete final exam and discuss course outcomes
Course Content (Lab)		**Assignments/Readings**
Week 1	Introduction to Tissue Processing	Read Chapter on Tissue Processing Techniques
Week 2	Hands-on experience with light microscopy and fluorescence microscopy	Study microscopy techniques and their clinical applications
Week 3	Digital Pathology Systems: Introduction and Practical Use	Review articles on digital pathology and its role in diagnostics
Week 4	Special Staining Procedures: Connective Tissue and Muscle Fibers	Read on different special stains used for tissue differentiation
Week 5	Special Staining Procedures: Microorganisms and Other Components	Research staining techniques for identifying microorganisms in tissues
Week 6	Immunohistochemistry (IHC) Principles and Antigen Retrieval	Study IHC methodology, antibody selection, and antigen retrieval
Week 7	Conducting IHC Experiments and Interpretation of Results	Read IHC protocols and practice interpreting IHC slides
Week 8	Molecular Diagnostics: DNA Extraction and PCR Techniques	Review molecular diagnostics methods, including DNA extraction and PCR
Week 9	Interpretation of Molecular Pathology Results	Study case examples of molecular diagnostics and their interpretation
Week 10	Histopathological Slide Analysis: Disease Diagnosis and Recognition	Practice analyzing histopathological slides for disease diagnosis
Week 11	Digital Image Analysis in Histopathology	Review software tools for image analysis in histopathology
Week 12	Quantification of Histopathological Features: Cell Counts, Staining Intensity	Study methods for quantifying histopathological features digitally
Week 13	Designing Tissue Microarrays for High-Throughput Analysis	Research tissue microarray technology and its applications in research
Week 14	Case Discussions with Healthcare Professionals	Participate in interdisciplinary case discussions for clinical correlation
Week 15	Quality Control Procedures: Slide Preparation, Staining Validation	Study laboratory standards for quality control in histopathology
Week 16	Review and Final Practical Assessment	Review all practical techniques and prepare for the final assessment

Textbooks and Reading Material

- Histopathology: A Practical Approach (3rd Edition) by Andrew S. C. Lee & Patricia S. R. Williams
- Basic Histopathology: A Textbook of Tumor Pathology (2nd Edition) by S. L. Gupta & S. K. Sharma
- Molecular Pathology: The Molecular Basis of Human Disease (4th Edition) by William B. Coleman & Gregory J. Tsongalis
- Immunohistochemistry: Basics and Methods (2nd Edition) by D. S. B. Sampson & L. A. Sherry
- Histotechnology: A Self-Instructional Text (4th Edition) by Freida L. Carson & Christa H. Hladik
- Mills, S. E. (2019). *Histology for Pathologists*. LWW.

- Perry, A., & Brat, D. J. (2017). *Practical Surgical Neuropathology: A Diagnostic Approach*. Churchill Livingstone.
- Kumar, V., Abbas, A. K., Aster, J. C., & Perkins, J. A. (2020). *Robbins and Cotran Pathologic Basis of Disease*. Saunders.
- Dabbs, D. J. (2018). *Diagnostic Immunohistochemistry: Theranostic and Genomic Applications*. Saunders.
- Goldblum, J. R., Lamps, L., McKenney, J. K., & Myers, J. L. (2017). *Rosai and Ackerman's Surgical Pathology*. Elsevier.

Teaching Learning Strategies

1. **Interactive Lectures**
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2. **Collaborative Learning**
   Students will work in pairs or small groups to write essays, analyze readings, and give peer feedback on presentations.
3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

1. Quiz-1
2. Quiz-II
3. Presentation
4. Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Programme	Medical Laboratory Technology	Course Code	MLT-410	Credit Hours	3 (0+3)
Course Title	Capstone Project				

Course Introduction

The **Medical Laboratory Technology Capstone Project** is the final milestone of the Bachelor of Science (BS) in Medical Laboratory Technology program. In this project, students choose and explore complex laboratory issues, conduct thorough research, analyze data, and present their findings. The capstone serves as a demonstration of their expertise, contributing valuable insights to the field. It prepares students for careers in Medical Laboratory Technology and research, while addressing practical challenges in the field, including forensic applications.

Learning Outcomes

On the completion of the course, the students will:

- **Apply Research Skills:** Demonstrate the ability to design, conduct, and analyze research in the field of Medical Laboratory Technology, addressing complex laboratory issues.
- **Critical Thinking and Problem-Solving:** Utilize critical thinking and problem-solving techniques to analyze data, interpret results, and draw meaningful conclusions from laboratory investigations.
- **Effective Communication:** Present research findings clearly and professionally, both in written reports and oral presentations, to diverse audiences including peers, faculty, and industry professionals.
- **Contribute to the Field:** Make a meaningful contribution to the field of Medical Laboratory Technology by addressing real-world challenges and providing solutions that can impact practice, policy, or further research.
- **Professional Development:** Prepare for advanced careers in medical laboratory technology or research by applying theoretical knowledge to practical, real-world situations, with an emphasis on forensic challenges and innovations.

Content

A capstone project is a multifaceted academic experience typically required for students during the final year of an academic program. It is a comprehensive and Compulsory project that often requires students to apply the knowledge and skills acquired throughout their academic careers to solve real-world problems or issues.

Capstone projects come in all shapes and sizes, including research papers, case studies, creative works, internships, and field placement projects. They are designed to challenge students to think critically, solve complex problems, and demonstrate their readiness for work in their field. Capstone projects are often a highlight of a student's academic career and can provide valuable experience and skills for their future endeavors.

Programme	Medical Laboratory Technology	Course Code	MLT-411	Credit Hours	1
Course Title	Scientific Writings				

Course Introduction

This course, **Scientific Writing**, is designed for students in the field of Allied Health Sciences who wish to develop essential skills in writing scientific documents, including research reports, research papers, and thesis dissertations. It provides a comprehensive overview of the key elements of scientific writing, with a focus on the structure and components of research reports, methods for writing research papers, publication processes, ethical considerations in research, and effective presentation techniques. The course will equip students with the knowledge and skills required to produce high-quality scientific documents and communicate their research findings effectively. Through theoretical lectures and practical assignments, students will learn how to write, revise, and present their research in a clear, concise, and professional manner. This course will also introduce students to the use of digital tools and resources to aid their research, referencing, and publication processes.

By the end of this course, students will be prepared to write and publish research articles, navigate the peer review process, and present their work at scientific conferences.

Learning Outcomes

On the completion of the course, the students will:

- Learn the structure and components of research reports, papers, and theses.
- Develop skills to write clear, concise, and well-organized scientific content.
- Understand the publication process, including peer review and journal selection.
- Explore ethical considerations in research, including informed consent and responsible conduct.
- Gain proficiency in using research tools, reference management software, and presenting research findings.

Course Content		Assignments/Readings
Week 1	Scientific Writing: Research Reports and Thesis	Structure and components of research reports and thesis
Week 2	Scientific Writing: Research Reports and Thesis	Guidelines for effective scientific writing
Week 3	Scientific Writing: Research Reports and Thesis	Writing research objectives, methods, results, and discussion sections
Week 4	Research Paper: Research Articles and Review Articles	Differentiating between research articles and review articles
Week 5	Research Paper: Research Articles and Review Articles	Structure and elements of research articles
Week 6	Research Paper: Research Articles and Review Articles	Writing a research article: introduction, methods, results, discussion
Week 7	Journal Publication, Peer Review, and Citation Styles	Publication process and journal selection
Week 8	Journal Publication, Peer Review, and Citation Styles	Peer review process and responding to reviewer comments
Week 9	Journal Publication, Peer Review, and Citation Styles	Citation styles and referencing techniques
Week 10	Ethical Considerations in Research	Research ethics and responsible conduct
Week 11	Ethical Considerations in Research	Informed consent and protection of human subjects
Week 12	Ethical Considerations in Research	Ethical issues in clinical research

Week 13	Research Poster Presentation	Designing effective research posters
Week 14	Research Poster Presentation	Creating visually appealing content
Week 15	Research Poster Presentation	Presenting research posters confidently
Week 16	Research Tools and Resources	Introduction to statistical software and data analysis tools Utilizing research tools: Google Scholar, Science Direct, PubMed Reference management software (e.g., EndNote) and identifying reputable journals

Textbooks and Reading Material

- Pajo, B. (2022). *Introduction to Research Methods: A Hands-on Approach*. Sage Publications.
- Kumar, A., & Ram, M. (2022). *Operations Research: Methods, Techniques, and Advancements*. CRC Press.
- Setchell, J. M. (2019). *Studying Primates: How to Design, Conduct, and Report Primatological Research*. Cambridge University Press.
- Cleland, J., & Durning, S. J. (2022). *Researching Medical Education*. John Wiley & Sons.
- Smith, J. A., & Johnson, R. B. (2020). *Research Skills and Scientific Writing: A Comprehensive Guide*. Academic Press.

Teaching Learning Strategies

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   Engage students with interactive presentations, discussions, and real-time corrections of writing and speaking errors.
2. **Collaborative Learning**
   Students will work in pairs or small groups to write essays, analyze readings, and give peer feedback on presentations.
3. **Case Studies**
   Use case studies to explore real-life examples of communication in business, academic, and casual settings.
4. **Role-Playing and Simulations**
   To practice persuasive speaking, public speaking, and informal conversations.
5. **Technology Integration**
   Use educational apps and software like Google Docs for collaborative writing and peer reviews, and Zoom for virtual presentations.

Assignments: Types and Number with Calendar

Quiz-1, Quiz-II, Presentation, Professional Writing Assignments

Assessment

Sr. No.	Elements	Weightage	Details
1.	Midterm Assessment	35%	Written Assessment at the mid-point of the semester.
2.	Formative Assessment	25%	Formative assessment includes: 1. Classroom presentations: 10 % 2. Quiz before mid-exam: 5% 3. Quiz before final-exam: 5% 4. Attendance regularity: 5%
3.	Final Assessment	40%	Written Examination at the end of the semester.

Checklist for a New Academic Program

Parameters	**YES/NO**	
1. Department Mission and Introduction	YES ☐	NO ☐
2. Program Introduction	YES ☐	NO ☐
3. Program Alignment with University Mission	YES ☐	NO ☐
4. Program Objectives	YES ☐	NO ☐
5. Market Need/ Rationale	YES ☐	NO ☐
6. Admission Eligibility Criteria	YES ☐	NO ☐
7. Duration of the Program	YES ☐	NO ☐
8. Assessment Criteria	YES ☐	NO ☐
9. Courses Categorization as per HEC Recommendation	YES ☐	NO ☐
10. Curriculum Difference	YES ☐	NO ☐
11. Study Scheme / Semester-wise Workload	YES ☐	NO ☐
12. Award of Degree	YES ☐	NO ☐
13. Faculty Strength	YES ☐	NO ☐
14. NOC from Professional Councils (if applicable)	YES ☐	NO ☐

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Program Coordinator **Chairperson**