Department of Molecular Diagnostics

Proposed Syllabi for all Courses



Prepared by

Abdelmuhsen Abusneina, PhD

March 9, 2023

Faculty of Biomedical Sciences
University of Benghazi

كلية العلوم الطبية الحيوية
جامعة بنغازي

التاريـــــــخ: 11_/ مارس/2023
الرقم الأشاري :2.و.ك_ ٩٠ /2023

السادة الأفاضل /السيدات الفضليات:

- ☐ د.توفيق عبدالله التواتي -رئيس قسم التشخيص الجزيـــــئي
- ☐ د.زينب عبدالله الحـــرش -رئيس قسم التقنية الخلـــويـــــة
- ☐ د.طارق عاشور المســماري -رئيس قسم علوم الطب الشرعـــي
- ☐ د.ناصر عثمان البرغـــثي -رئيس قسم علوم المختبرات الطبـية
- ☐ أ.سالمة عمر الزائـــــدي -رئيس قسم إدارة المختـــــبرات
- ☐ أ.علي محمد كشيـــــش -منسق المرحلة الأولـــــــــى

تحية طيبة وبعد،

أحيل اليكم توصيف **27** مقرر لكل قسم (التخصصية ومتطلبات الكلية) للسنوات الدراسية الثانية والثالثة والرابعة. هذا التوصيف هو عبارة عن مسودة أولى، والذي قمت بإعداده حسب ما توفر لي من الوقت، ليتم الاسترشاد به وان يتم مراجعته والعمل على تحسينه، إذا تطلب الأمر، من قبل مختصين بالقسم، مع مراعاة المفهوم العام لكل تخصص، ولكي نصل به جميعا الى المستوى المطلوب.

ارجوا أن تتقبلوا مني هذا الجهد المتواضع، وأتمنى أن يكون هذا المنتوج لبنة أولى لتحسين القدرات العلمية لكل الأقسام العلمية بالكلية. وكما أتمنى ان تلتمسوا لي العذر في حال حصول نقص أو تقصير.

ستجدون مرفقا بهذه الرسالة: 3 مجلدات (مجلد لكل سنة دراسية لكل قسم)

كل توصيف مقرر يحتوي على:

Course Syllabus	محتويات التوصيف
• Course Description and Aims	• نبذة عن المقرر وأهدافه
• Intended Learning Outcomes:	• النتائج المتوقعة للتعلم:
○ Knowledge and Understanding:	○ المعرفة والفهم
○ Intellectual Skills:	○ المهارات الفكرية
○ Professional and Practical Skills:	○ المهارات المهنية والعملية
○ General Transferable Skills:	○ المهارات العامة القابلة للنقل
• Course Topics	• محتويات المقرر (النظرية)
• Practical Classes	• محتويات الدروس العملية
• Course References:	• المراجع

ملاحظة: هذا يشكل معظم ما يتطلبه نموذج الجودة لمقرر ما.

www.bmtuob.edu.ly
info.bioMedScis@uob.edu.ly
+218.61.223.0200
بنغازي.ليبيا

كذلك، ستجدون مرفقا الآتي:

- الرؤية والرسالة والأهداف لكل قسم علمي (باللغتين العربية والإنجليزية).
- مقترح لبرنامج التدريب الميداني في تخصص كل قسم بعدد 10 ساعات أسبوعية لمدة 24 أسبوع.
- عدد من النماذج الخاصة بالمقررات والتدريب الميداني وذلك لتنظيم الدراسة وهي:

English Title	المسمى باللغة العربية
• **Undergraduate Thesis Forms:**	**نماذج خاصة بالأطروحة (مشروع التخرج)**
○ Undergraduate thesis proposal registration form	نموذج تسجيل مقترح إطروحة بكالوريوس
○ Student Progress Form	نموذج تقرير مستوى تقدم الطالب في إنجاز الإطروحة
○ Thesis Evaluation Form	نموذج تقييم الأطروحة
○ Thesis Defense Evaluation Form	نموذج تقييم العرض الخاص بالأطروحة
• **Student Seminar Evaluation Form**	**نموذج تقييم أداء الطالب في الندوة العلمية**
• **Student Performance Evaluation Form for Workplace Experience**	**نموذج تقييم أداء الطالب في التدريب الميداني**
• **Student Evaluation Forms:**	**نماذج خاصة بالطالب:**
○ Evaluation Form for Undergraduate Course	نموذج تقييم لتجربة الطالب بالمقرر
○ Evaluation Form for Workplace Experience	نموذج تقييم لتجربة الطالب بالتدريب الميداني
• **letterhead format**	**نموذج ورقة معنونة للقسم**

رجاء، لا تترددوا في الاتصال بي في حال لديكم أي استفسارات

أتمنى لكم كل التوفيق

والسلام عليكم ورحمة الله وبركاته

د. عبدالمحسن محمد بوسنينة

وكيل الكلية للشؤون العلمية

نسخة لكل من:

السيد/د.وكيل الجامعة للشؤون العلمية- للتفضل بالاطلاع.

السيدة/د. عميد الكلية- للتفضل بالاطلاع.

السيد/د. مدير إدارة الجودة وتقييم الأداء بالجامعة-للتفضل بالاطلاع.

السيدة/د. مدير قسم الجودة وتقييم الأداء بالكلية-للتفضل بالاطلاع.

السيد/أ. مسجل الكلية-للتفضل بالاطلاع.

السيد/أ. منسقي الجودة وتقييم الأداء بالأقسام العلمية-للتفضل بالاطلاع.

الملف الصـــــــــــادر.

الملف الدوري العـــــــــأم.

بوسنينة

www.bmt.uob.edu.ly
info.bioMedScis@uob.edu.ly
+218.61.223.0200
بنغازي.ليبيا

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الرؤية والرسالة والأهداف لقسم التشخيص الجزيئي

الرؤية:

أن يصبح برنامج التشخيص الجزيئي رائدًا في مجال التشخيص الطبي المتخصص على المستوى المحلي والعالمي ، ومساهمًا في تحسين جودة الرعاية الصحية.

الرسالة:

يهدف برنامج التشخيص الجزيئي إلى تدريب الطلاب على فهم وتطبيق التقنيات الجزيئية في التشخيص الطبي. ويسعى البرنامج إلى توفير الفرص اللازمة للطلاب لتعلم المبادئ الأساسية للجينات والجزيئات المعقدة التي تتحكم في الصحة والمرض. كما يهدف البرنامج إلى تزويد الطلاب بالمهارات والخبرات اللازمة لتطوير وتحسين التشخيص الطبي.

الأهداف:

- **توفير تعليم عالي الجودة في مجال التشخيص الجزيئي.**
- **توفير الفرص اللازمة للطلاب لتطوير المهارات العلمية والتقنية اللازمة للعمل في مجال التشخيص الجزيئي.**
- **تدريب الطلاب على استخدام التقنيات الجزيئية المتقدمة في التشخيص الطبي.**
- **تشجيع الطلاب على التفكير النقدي والإبداع في مجال التشخيص الجزيئي.**
- **تطوير برامج البحث العلمي التطبيقي المتعلقة بالتشخيص الجزيئي.**
- **تعزيز الاتصال والتعاون بين المتخصصين في مجال التشخيص الجزيئي والمؤسسات الطبية والصناعية ذات الصلة.**

Vision, Mission, and Objectives for the Department of Molecular Diagnostics

Vision:

To become a leading program in specialized medical diagnosis at the local and global level, contributing to improving the quality of healthcare.

Mission:

The Molecular Diagnosis Program aims to train students to understand and apply molecular techniques in medical diagnosis. The program seeks to provide students with the necessary opportunities to learn the basic principles of genes and complex molecules that control health and disease. Additionally, the program aims to provide students with the skills and experience necessary to develop and improve medical diagnosis.

Objectives:

- To provide high-quality education in the field of molecular diagnosis.
- To provide students with the necessary opportunities to develop scientific and technological skills necessary to work in the field of molecular diagnosis.
- To train students to use advanced molecular techniques in medical diagnosis.
- To encourage students to think critically and creatively in the field of molecular diagnosis.
- To develop applied scientific research programs related to molecular diagnosis.
- To promote communication and collaboration between specialists.

University of Benghazi

Faculty of Biomedical Sciences
Department of Molecular Diagnostics

Course Requirements for Molecular Diagnostics (MOLD) BSc Degree

1st YEAR							
No	Course title		Course Code	Cr. hrs	Teaching hrs		Remarks
	English	Arabic			Th	lab	
1	Anatomy and Physiology	علم التشريح ووظائف الأعضاء	ANAT-101	4	3	2	
2	Applied Mathematics	الرياضيات التطبيقية	BMSC-101	2	2	-	
3	Computer Skills	مهارات الحاسوب	BMSC-102	2	1	2	
4	Cytology and Histology	علم الخلية و الأنسجة	CYTO 103	4	3	2	
5	Fundamentals of Biochemistry	إساسيات الكيمياء الحيوية	MLSC-101	4	3	2	
6	General Forensic Sciences	علوم الطب الشرعي العام	FRSC-101	4	3	2	
7	General Microbiology	علم الأحياء الدقيقة العام	MLSC-102	4	3	2	
8	Hematology and Immunology	علم الدم والمناعة	MLSC-103	4	3	2	
9	Scientific Skills and Communication	المهارات العلمية والتواصل	BMSC-103	3	2	2	
CREDIT HOURS				**31**			
2nd YEAR							
No	Course title		Course Code	Cr. hrs	Teaching hrs		Remarks
	English	Arabic			Th	lab	
1	Biological Basis of Disease	الأسس الحيوية للمرض	MOLD-201	4	3	2	
2	Cell and Molecular Biology	علم الأحياء الخلوي والجزيئي	MOLD-203	3	2	2	
3	Clinical Biochemistry	الكيمياء الحيوية السريرية	MLSC-201	4	3	2	
4	Integrative Physiology	علم وظائف الأعضاء التكاملي	BMSC-201	4	3	2	
6	Lab Management and Medical Informatics	إدارة المختبرات والمعلوماتية الطبية	LBMT-202	2	2	-	
5	Medical Immunology	علم المناعة الطبية	MLSC-205	4	3	2	
7	Medical Microbiology	علم الأحياء الدقيقة الطبية	MLSC-206	4	3	2	
8	Molecular Biology Techniques	تقنيات علم الاحياء الجزيئي	MOLD-204	2	1	2	
9	Principles of Human Genetics	مبادئ علم الوراثة البشري	MOLD-205	4	3	2	
CREDIT HOURS				**31**			
3RD YEAR							
No	Course title		Course Code	Cr. hrs	Teaching hrs		Remarks
	English	Arabic			Th	lab	
1	Bioinformatics and Genomics	المعلوماتية الحيوية وعلم الجينوم	MOLD-301	4	3	2	
2	Clinical Molecular Diagnostic Techniques	تقنيات التشخيص الجزيئي السريري	MOLD-303	2	1	2	
3	Histotechnology	التقنية النسيجية	CYTO-305	3	2	2	
4	Medical Genetics	علم الوراثة الطبية	MOLD-304	3	2	2	
5	Molecular Basis of Disease	الأسس الجزيئية للمرض	MOLD-305	4	3	2	
6	Molecular Immunology	علم المناعة الجزيئي	MOLD-307	4	3	2	
7	Molecular Oncology	علم الأورام الجزيئي	MOLD-308	3	2	2	
8	Research Methodology and Data Analysis	طرق البحث وتحليل البيانات	BMSC-301	4	3	2	
9	Specimen Procurement and Documentation	العينات والتوثيق	MLSC-307	2	1	2	
CREDIT HOURS				**29**			
4TH YEAR							
No	Course title		Course Code	Cr. hrs	Teaching hrs		Remarks
	English	Arabic			Th	lab	
1	Biomedical Ethics and Scientific Integrity	إخلاقيات الطب الحيوي والنزاهة العلمية	BMSC-401	2	2	-	
2	Diagnostic Genetics	علم الوراثة التشخيصية	MOLD-401	4	3	2	
3	Infection Control and Safety	مكافحة العدوى والسلامة	BMSC-402	2	2	-	
4	Molecular Diagnostic of Hematopathology and Oncology	التشخيص الجزيئي لأمراض الدم والأورام	MOLD-402	3	2	2	
5	Molecular Diagnostic of Infectious Diseases	التشخيص الجزيئي للأمراض المعدية	MOLD-403	3	2	2	
6	Molecular Therapeutics	المداواة الجزيئية	MOLD-405	3	2	2	
8	Seminar in Molecular Diagnostics	ندوة في التشخيص الجزيئي	MOLD-408	1	1	-	
9	Thesis	مشروع التخرج	MOLD-409	4	4	-	
7	Workplace Experience	التدريب الميداني	MOLD-410	10	-	10	
Credit Hours				**32**			
TOTAL CREDIT HOURS				123			

Course Requirements for Molecular Diagnostics (MOLD) BSc Degree

Department of Molecular Diagnostics

Proposed Syllabi for all Courses in the Second Year



Prepared by

Abdelmuhsen Abusneina, PhD

March 9, 2023

Syllabus of Second Year Courses

1	Course title: Biological Basis of Disease	Course Code: MOLD-201

Overall Description and Aims:

The course is designed to provide students with a comprehensive understanding of the biological mechanisms underlying disease development, progression, and treatment. The course is aimed at developing a strong foundation in the fundamental principles of pathology, immunology, microbiology, pharmacology, and genetics.

Intended Learning Outcomes of the Course: By the end of the course, students should be able to demonstrate the following:

Knowledge and Understanding:

1. An in-depth understanding of the biological basis of disease.
2. The fundamental principles of pathology, including the concept of disease, etiology, pathogenesis, and morphological changes associated with diseases.
3. The cellular responses to injury and the molecular mechanisms that underlie these responses.
4. The role of inflammation and immunity in the pathogenesis of diseases.
5. The principles of neoplasia, including the molecular mechanisms that underlie the development and progression of cancer.
6. The principles of systemic pathology, including the major diseases affecting each organ system.

Intellectual Skills:

1. The ability to analyze and interpret pathological data from clinical and laboratory investigations.
2. The ability to apply knowledge of pathological principles to diagnose and manage diseases.
3. The ability to critically evaluate scientific literature and research related to pathology.
4. The ability to design and execute experiments related to pathology.

Professional and Practical Skills:

1. The ability to effectively communicate pathological concepts to healthcare professionals and patients.
2. The ability to work collaboratively with healthcare professionals in the diagnosis and management of diseases.
3. The ability to use laboratory investigations to diagnose and manage diseases.
4. The ability to critically evaluate laboratory investigations and their role in the diagnosis and management of diseases.

General Transferable Skills:

1. The ability to effectively communicate complex information to a diverse audience.
2. The ability to work independently and as part of a team to achieve common goals.
3. The ability to use problem-solving skills to address complex issues.

Course Topics:

1. Fundamentals of Pathology: Understanding the principles of pathology and disease processes.
2. Cellular and Molecular Basis of Disease: Understanding the cellular and molecular mechanisms underlying diseases.
3. Immunology and Disease: Understanding the basic principles of the immune system and its role in disease.
4. Microbiology and Disease: Understanding the basic principles of microbiology and its role in disease.
5. Genetics and Genomics in Disease: Understanding the role of genetics and genomics in disease development.
6. Cardiovascular Diseases: Understanding the pathogenesis and management of cardiovascular diseases.
7. Respiratory Diseases: Understanding the pathogenesis and management of respiratory diseases.
8. Gastrointestinal Diseases: Understanding the pathogenesis and management of gastrointestinal diseases.
9. Renal and Urinary Tract Diseases: Understanding the pathogenesis and management of renal and urinary tract diseases.
10. Endocrine and Metabolic Diseases: Understanding the pathogenesis and management of endocrine and metabolic diseases.

11. Neurological Diseases: Understanding the pathogenesis and management of neurological diseases.
12. Musculoskeletal Diseases: Understanding the pathogenesis and management of musculoskeletal diseases.
13. Oncology: Understanding the basic principles of cancer development.
14. Infectious Diseases: Understanding the mechanisms by which infectious agents cause disease and their management.
15. Hematological Diseases: Understanding the pathogenesis and management of hematological diseases.
16. Laboratory Safety: Understanding and implementing laboratory safety protocols.
17. Biomarkers and Diagnostics: Understanding the principles and techniques of biomarkers and diagnostics in disease diagnosis and management.
18. Biological Basis of Disease: Understanding the principles and concepts underlying the course.
19. Immune System Disorders: Understanding the mechanisms of immune system disorders and their management.
20. Genetic Disorders: Understanding the mechanisms of genetic disorders and their management.
21. Neurological Disorders: Understanding the mechanisms of neurological disorders and their management.
22. Dermatological Disorders: Understanding the mechanisms of dermatological disorders and their management.
23. Introduction to Pathology: Understanding the basic principles of pathology, including the concept of disease, etiology, pathogenesis, and morphological changes associated with diseases.
24. Cellular Responses to Injury: Understanding the cellular responses to injury and the molecular mechanisms that underlie these responses.
25. Acute Inflammation: Understanding the pathogenesis of acute inflammation and the cellular and molecular mechanisms involved in the response.
26. Chronic Inflammation: Understanding the pathogenesis of chronic inflammation and the cellular and molecular mechanisms involved in the response.
27. Tissue Repair and Regeneration: Understanding the cellular and molecular mechanisms of tissue repair and regeneration.
28. Hemodynamic Disorders: Understanding the pathogenesis of hemodynamic disorders and their effects on various organ systems.
29. Genetic and Developmental Disorders: Understanding the genetic and developmental basis of diseases.

30. Environmental Pathology: Understanding the effects of environmental factors on human health.
31. Immunopathology: Understanding the role of immunity in the pathogenesis of diseases.
32. Neoplasia: Understanding the principles of neoplasia, including the molecular mechanisms that underlie the development and progression of cancer.
33. Infectious Diseases: Understanding the pathogenesis and management of infectious diseases.
34. Nutritional and Metabolic Diseases: Understanding the pathogenesis and management of nutritional and metabolic disorders.
35. Endocrine Pathology: Understanding the pathogenesis and management of endocrine disorders.
36. Cardiovascular Pathology: Understanding the pathogenesis and management of cardiovascular diseases.
37. Respiratory Pathology: Understanding the pathogenesis and management of respiratory diseases.
38. Gastrointestinal Pathology: Understanding the pathogenesis and management of gastrointestinal diseases.

Practical Classes:

1. Basic Laboratory Skills - Developing basic laboratory skills such as pipetting, solution preparation, and microscopy.
2. Microbiological Techniques - Developing microbiological techniques such as culturing, staining, and identification.
3. Immunological Techniques - Developing immunological techniques such as ELISA, Western blotting, and flow cytometry.
4. Histological Techniques - Developing histological techniques such as tissue fixation, sectioning, and staining.
5. PCR and DNA Sequencing - Understanding the principles and techniques of PCR and DNA sequencing.
6. Cell Culture Techniques - Developing cell culture techniques such as cell line maintenance, transfection, and cell viability assays.
7. Gross examination of organs and tissues
8. Analysis of laboratory data and diagnostic tests
9. Preparation of tissue specimens for microscopic examination
10. Immunohistochemical staining techniques
11. Autopsy techniques and procedures
12. Blood and urine analysis
13. Microbial culture and identification

14. Examination of cardiovascular system in live patients
15. Examination of respiratory system in live patients

References:

1. Kumar, V., Abbas, A. K., Aster, J. C., & Robbins, S. L. (2019). Robbins basic pathology. Elsevier Health Sciences.

1. Cotran, R.S., Kumar, V., Collins, T. (1998). Robbins Pathologic Basis of Disease. Philadelphia, PA: Saunders.

2	Course title: Cell and Molecular Biology	Course Code: MOLD-203

Overall Description and Aims:

The course is a core module that aims to provide students with a fundamental understanding of the molecular and cellular processes that underpin human health and disease. The course covers a range of topics, from the basic structure and function of cells to advanced concepts such as gene expression and signaling pathways. It also includes practical sessions designed to provide students with hands-on experience in laboratory techniques commonly used in molecular and cellular biology.

Intended Learning Outcomes: After completing this course, students should be able to demonstrate:

Knowledge and Understanding:

1. An understanding of the basic structure and function of cells and the molecular components that underpin cellular processes.
2. Knowledge of molecular genetics, including DNA replication, transcription, translation, and gene regulation.
3. An understanding of the importance of protein structure and function in cellular processes, including enzymatic catalysis and molecular signaling.
4. An understanding of the major signaling pathways involved in cellular communication and their role in normal and disease states.

Intellectual Skills:

1. The ability to critically evaluate scientific literature and experimental data.
2. The ability to design and execute experimental protocols in molecular and cellular biology.
3. The ability to analyze and interpret data obtained from experiments.
4. The ability to develop hypotheses and design experiments to test them.

Professional and Practical Skills:

1. The ability to use laboratory equipment and perform basic techniques in molecular and cellular biology.
2. The ability to work effectively as part of a team in a laboratory setting.

3. The ability to analyze and interpret data obtained from experiments and present findings in written and oral formats.
4. The ability to conduct research in a responsible and ethical manner.

General Transferable Skills:

1. Effective communication skills.
2. Time-management and organizational skills.
3. Problem-solving and analytical skills.
4. The ability to work independently and take initiative.

Course Topics:

Introduction to Cell and Molecular Biology:

1. Historical perspectives and discoveries in cell and molecular biology
2. Basic principles and concepts of cell and molecular biology
3. Organization of living organisms, from cells to tissues to organs
4. Comparison of prokaryotic and eukaryotic cells
5. Applications of cell and molecular biology in biomedical research

Cell Structure and Function:

1. Membrane structure and function
2. Cytoskeleton and cell motility
3. Nucleus and nucleolus
4. Mitochondria and energy production
5. Endoplasmic reticulum and Golgi apparatus
6. Lysosomes and peroxisomes
7. Ribosomes
8. Centrosome
9. Microvilli
10. Flagella and cillia

Biomolecules:

1. Amino acids and protein structure
2. Carbohydrates and glycosylation
3. Lipids and membrane composition
4. Nucleotides and nucleic acid structure
5. Vitamins and coenzymes

Enzymes and Metabolism:

1. Enzyme kinetics and mechanism
2. Glycolysis and the Krebs cycle
3. Electron transport chain and oxidative phosphorylation
4. Biosynthesis of macromolecules
5. Regulation of metabolism

DNA Replication and Repair:

1. DNA replication machinery
2. DNA damage and repair mechanisms
3. Telomeres and telomerase
4. Mutations and genetic diseases
5. Epigenetic modifications and gene regulation

Transcription and RNA Processing:

1. Transcription initiation and elongation
2. RNA splicing and alternative splicing
3. RNA editing and modification
4. Post-transcriptional regulation of gene expression
5. Non-coding RNAs and their functions

Translation and Protein Folding:

1. Ribosome structure and function
2. Translation initiation, elongation, and termination
3. Protein folding and chaperones
4. Protein targeting and trafficking
5. Protein degradation and turnover

Genetic Variation and Mutation:

1. Mechanisms of genetic variation
2. Types of mutations and their effects
3. Genetic screening and diagnosis
4. Inheritance patterns and genetic counseling
5. Evolutionary implications of genetic variation and mutation

Recombinant DNA Technology:

1. Restriction enzymes and DNA cloning
2. Polymerase chain reaction (PCR)
3. DNA sequencing and genotyping
4. CRISPR-Cas gene editing
5. Applications of recombinant DNA technology in research and medicine

Genetic Engineering:

1. Genetic modification of organisms
2. Transgenic animals and plants
3. Gene therapy and its challenges
4. Synthetic biology and bioengineering
5. Ethics and regulation of genetic engineering

Genomics and Proteomics:

1. Genome sequencing and annotation
2. Transcriptomics and gene expression profiling
3. Proteomics and protein identification
4. Metabolomics and metabolic profiling
5. Systems biology and network analysis

Gene Expression and Regulation:

1. Transcriptional regulation of gene expression
2. Chromatin structure and remodeling
3. Regulatory proteins and cis-acting elements
4. Epigenetic modifications and gene regulation
5. Post-transcriptional regulation of gene expression

Cellular signaling and its regulation:

1. Extracellular signals and receptors
2. Signal transduction pathways
3. Second messengers and signaling cascades
4. Feedback mechanisms and signal amplification
5. Crosstalk between signaling pathways

Signal Transduction Pathways:

1. Receptor tyrosine kinases and intracellular signaling

2. G protein-coupled receptors and G proteins
3. Protein kinase signaling cascades
4. Calcium signaling and its regulation
5. Signaling pathways involved in development and disease

• Genomics and Proteomics:

1. Techniques in genomics and proteomics
2. Gene expression profiling
3. Genome sequencing and annotation
4. Structural and functional genomics
5. Comparative genomics and evolutionary genomics

• Gene Expression and Regulation:

1. Transcriptional regulation in prokaryotes
2. Transcriptional regulation in eukaryotes
3. Post-transcriptional regulation
4. Epigenetic regulation
5. Genetic and environmental factors affecting gene expression

• Cellular Signaling and its Regulation:

1. Signal transduction pathways
2. G protein-coupled receptors (GPCRs)
3. Receptor tyrosine kinases (RTKs)
4. Intracellular signaling molecules
5. Cross-talk between signaling pathways

• Signal Transduction Pathways:

1. Second messengers and their regulation
2. Protein kinases and phosphatases
3. Calcium signaling
4. MAPK signaling pathway
5. Wnt and Hedgehog signaling pathways

• Intracellular Vesicular Transport:

1. Endocytosis and exocytosis
2. Vesicular trafficking

3. Endoplasmic reticulum and Golgi apparatus
4. Lysosomes and peroxisomes
5. Autophagy and mitophagy

• Cell Cycle and Division:

1. Cell cycle checkpoints
2. Cyclins and cyclin-dependent kinases
3. Mitosis and cytokinesis
4. Meiosis and genetic recombination
5. Regulation of cell cycle progression

• Apoptosis and Cell Death:

1. Mechanisms of apoptosis
2. Regulation of apoptosis
3. Caspases and their regulation
4. Necrosis and other forms of cell death
5. Implications of cell death in disease and development

• Cancer Biology:

1. Tumor suppressor genes
2. Oncogenes and their activation
3. DNA damage and repair in cancer
4. Metastasis and angiogenesis
5. Cancer treatment and targeted therapy

• Stem Cells and Regeneration:

1. Types of stem cells
2. Self-renewal and differentiation
3. Stem cell niche and microenvironment
4. Regeneration and tissue repair
5. Stem cells in disease and therapy

Practical Classes:

1. Microscopy Techniques
2. Cell Culture
3. Protein Purification

4. DNA Extraction and Purification
5. PCR and Gel Electrophoresis
6. Western Blotting
7. Enzyme Assays
8. Cell Fractionation and Membrane Transport
9. Immunofluorescence and Confocal Microscopy
10. CRISPR/Cas9 Gene Editing
11. RNA Interference (RNAi)
12. Fluorescence-Activated Cell Sorting (FACS)
13. Bioinformatics and Genomic Data Analysis
14. Proteomics and Mass Spectrometry
15. Cell-Based Assays for Drug Screening
16. Tissue Engineering and 3D Cell Culture
17. Microbial Culturing and Identification
18. Antibiotic Sensitivity Testing
19. Clinical Laboratory Techniques

References:

1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2015). Molecular biology of the cell (6th ed.). Garland Science.
2. Lodish, H., Berk, A., Zipursky, S. L., Matsudaira, P., Baltimore, D., & Darnell, J. (2016). Molecular cell biology (8th ed.). W. H. Freeman and Company.

3	Course title: Clinical Biochemistry	Course Code: MLSC-201

Description and Aims:

The course aims to provide students with a comprehensive understanding of the biochemical principles underlying human disease and to develop their knowledge and skills in clinical laboratory science, including the ability to interpret laboratory data. This course covers a wide range of topics including basic analytical techniques, metabolism and disease, endocrine and reproductive systems, renal and liver function, and therapeutic drug monitoring. It also provides fundamental knowledge of the structure and function of biomolecules and their role in human physiology, health, and disease. Through a combination of lectures, practical classes, and case-based learning, students will acquire a solid foundation in the principles and practices of clinical chemistry, which are essential for a career in clinical laboratory science, medicine, or related fields.

Intended Learning Outcomes:

At the end of the course, students should have acquired:

Knowledge and Understanding:

- A comprehensive understanding of the biochemical basis of human disease
- A detailed understanding of the principles of clinical laboratory science
- A knowledge of the most important biochemical analyses used in clinical biochemistry

Intellectual Skills:

- The ability to critically evaluate and interpret biochemical data
- The ability to integrate and apply knowledge from different areas of biochemistry and biomedical sciences

Professional and Practical Skills:

- The ability to perform laboratory tests in clinical biochemistry
- The ability to use standard operating procedures and quality control measures in the clinical laboratory.

- Demonstrate knowledge of the metabolic pathways and biochemical processes involved in the diagnosis and management of diseases
- Understand the roles of various organs and organ systems in the regulation of biochemical homeostasis
- The ability to interpret laboratory data in the context of patient care

General Transferable Skills:

- The ability to work effectively in a team
- The ability to communicate complex scientific concepts effectively
- The ability to apply analytical and problem-solving skills in a range of settings
- Manage time effectively and prioritize tasks

Course Topics:

1. Introduction to Clinical Biochemistry

- Introduction to the course
- The role of clinical biochemistry in healthcare
- History and development of clinical biochemistry
- Basic analytical techniques in clinical chemistry

2. Biomolecules and their Properties

- Structure and function of proteins
- Structure and function of lipids
- Structure and function of carbohydrates

3. Metabolism

- Overview of metabolic pathways
- Glycolysis and gluconeogenesis
- TCA cycle and electron transport chain

4. Enzymes and Their Kinetics

- Enzyme classification and nomenclature
- Enzyme kinetics and Michaelis-Menten equation
- Factors affecting enzyme activity

2. Carbohydrate Metabolism and Diabetes

- Biochemistry of carbohydrates and their metabolism
- Pathophysiology of diabetes mellitus
- Laboratory tests for diabetes diagnosis and management

3. Lipid Metabolism and Cardiovascular Disease

- Biochemistry of lipids and their metabolism
- Pathophysiology of atherosclerosis and cardiovascular disease
- Laboratory tests for lipid disorders and cardiovascular risk assessment

4. Protein Metabolism and Renal Function

- Biochemistry of proteins and their metabolism
- Pathophysiology of renal disease
- Laboratory tests for renal function assessment and proteinuria

5. Liver Function and Hepatobiliary Diseases

- Biochemistry of liver function and metabolism
- Pathophysiology of hepatobiliary diseases
- Laboratory tests for liver function assessment and hepatobiliary disorders

6. Endocrine and Reproductive Systems

- Biochemistry of hormones and their regulation
- Pathophysiology of endocrine and reproductive disorders
- Laboratory tests for endocrine and reproductive function assessment

5. Hormones and Signaling

- Overview of hormone signaling
- Hormone biosynthesis and regulation
- Mechanisms of hormone action

6. Biochemical Techniques

- Chromatography
- Spectrophotometry
- Electrophoresis

7. Diagnostic Techniques in Clinical Biochemistry

- Analytical methods in clinical biochemistry
- Immunoassays
- Molecular diagnostics

8. Acid-Base Balance and Electrolytes

- Physiology of acid-base balance and electrolyte regulation
- Pathophysiology of acid-base and electrolyte disorders
- Laboratory tests for acid-base and electrolyte assessment

14. Hematology and Coagulation Disorders

- Overview of hematological disorders and their diagnosis
- Biochemistry of coagulation and hemostasis
- Laboratory tests for hematology and coagulation assessment

15. Clinical Enzymology and Analytical Techniques

- Biochemistry of enzymes and their regulation
- Principles of analytical techniques in clinical chemistry
- Laboratory tests for enzyme activity and measurement

16. Trace Elements and Minerals

- Biochemistry of trace elements and minerals
- Pathophysiology of trace element and mineral disorders
- Laboratory tests for trace element and mineral assessment

14. Iron Metabolism

- Overview of iron metabolism
- Iron deficiency anemia
- Hemochromatosis

15. Inborn Errors of Metabolism

- Overview of inborn errors of metabolism
- Diagnosis and management of inborn errors of metabolism
- Newborn screening

Practical Classes:

1. Introduction to Clinical Chemistry Assays

- To perform basic clinical chemistry assays (e.g. glucose, creatinine, urea) using standard laboratory procedures and equipment
- To understand the principles of quality control and assurance in clinical chemistry testing

2. Serum Lipid Assays

- To perform lipid assays (e.g. cholesterol, triglycerides) using standard laboratory procedures and equipment
- To interpret lipid assay results in the context of cardiovascular risk assessment

3. Urine Analysis and Renal Function Tests

- To perform urine analysis (e.g. dipstick, microscopy) using standard laboratory procedures and equipment
- To perform renal function tests (e.g. creatinine clearance, albuminuria) using standard laboratory procedures and equipment

4. Liver Function Tests

- To perform liver function tests (e.g. AST, ALT, ALP, bilirubin) using standard laboratory procedures and equipment
- To interpret liver function test results in the context of hepatobiliary disease diagnosis and management

5. Glucose Tolerance Test

- To perform a glucose tolerance test using standard laboratory procedures and equipment
- To interpret glucose tolerance test results in the context of diabetes diagnosis and management

6. Hormone Assays

- To perform hormone assays (e.g. TSH, LH, FSH) using standard laboratory procedures and equipment

- To interpret hormone assay results in the context of endocrine disorders

7. Therapeutic Drug Monitoring Assays

- To perform therapeutic drug monitoring assays (e.g. digoxin, theophylline) using standard laboratory procedures and equipment
- To interpret therapeutic drug monitoring assay results in the context of medication dosage adjustment and toxicity monitoring

8. Blood Gas Analysis

- To perform blood gas analysis (e.g. pH, pCO2, pO2) using standard laboratory procedures and equipment
- To interpret blood gas analysis results in the context of acid-base disorders and respiratory dysfunction

9. Coagulation Assays

- To perform coagulation assays (e.g. PT, APTT) using standard laboratory procedures and equipment
- To interpret coagulation assay results in the context of hemostatic disorders

10. Immunological Assays

- To perform immunological assays (e.g. ELISA, Western blot) using standard laboratory procedures and equipment
- To interpret immunological assay results in the context of autoimmune and infectious diseases

11. Enzyme Assays

- To perform enzyme assays (e.g. amylase, lipase) using standard laboratory procedures and equipment
- To interpret enzyme assay results in the context of pancreatic and other organ dysfunction

13. Laboratory Data Analysis

- To analyze and interpret laboratory data using appropriate statistical and graphical methods
- To identify sources of variation and error in laboratory data and develop strategies for quality improvement

16. Laboratory Management and Instrumentation

- To understand the principles of laboratory management and resource utilization
- To understand the basic concepts of clinical chemistry instrumentation and operation

17. Case-Based Learning

- To apply knowledge and skills learned in the course to real clinical cases
- To develop critical thinking and problem-solving skills in the context of clinical chemistry testing and interpretation

18. Team-Based Learning

- To work collaboratively in teams to solve clinical chemistry problems and cases
- To develop communication and teamwork skills in the context of laboratory medicine

References:

1. Tietz NW, Pruden EL, Siggaard-Andersen O. Clinical Guide to Laboratory Tests. 4th ed. Philadelphia, PA: W.B. Saunders Company; 2006.
2. Marshall WJ, Bangert SK. Clinical Chemistry: Principles and Practice. 2nd ed. London, UK: CRC Press; 2016.

4	Course title: Integrative Physiology	Course Code: BMSC-201

Overall Aims of the Course:

The overall aim of this course is to provide students with a comprehensive understanding of the fundamental principles of physiology and the role of different physiological systems in maintaining health and responding to environmental challenges. By the end of the course, students should have the ability to critically analyze the function of different physiological systems and their interactions, and apply this knowledge to the study of human health and disease.

Intended Learning Outcomes of the Course: Upon completion of this course, students should be able to:

1. Demonstrate an understanding of the fundamental principles of physiology and homeostasis
2. Analyze the organization and function of different physiological systems in the body
3. Evaluate the mechanisms that control cellular communication and signaling pathways
4. Understand the role of different physiological systems in maintaining homeostasis and responding to environmental challenges
5. Describe the function of the reproductive system and its hormonal regulation
6. Demonstrate the ability to design and conduct laboratory experiments in physiology
7. Analyze and interpret experimental data and draw appropriate conclusions

Intellectual Skills:

1. Critical analysis and evaluation of physiological concepts and mechanisms
2. Synthesis of complex physiological systems and their interactions
3. Application of physiological principles to human health and disease
4. Evaluation of experimental design and interpretation of results

Professional and Practical Skills:

1. Effective communication of physiological concepts and mechanisms
2. Collaboration and teamwork in the laboratory setting

General Transferable Skills:

- Critical thinking and problem-solving
- Independent learning and study
- Time management and organization

Course topics

1: Introduction to Physiology and Homeostasis

- Overview of physiology and its importance
- Homeostasis and its role in maintaining physiological equilibrium

2: Cellular Communication and Signaling Pathways

- Overview of cellular communication
- Signaling pathways and their importance in physiology

3: Membrane Transport and Energy Metabolism

- Structure and function of cell membranes
- ATP production and energy metabolism

4: Nervous System and Sensory Physiology

- Anatomy and function of the nervous system
- Sensory physiology and perception

5: Cardiovascular System and Blood Pressure Regulation

- Anatomy and function of the cardiovascular system
- Regulation of blood pressure

6: Respiratory System and Gas Exchange

- Anatomy and function of the respiratory system
- Gas exchange and regulation of breathing

7: Renal System and Water Balance

- Anatomy and function of the renal system
- Regulation of water balance and electrolytes

8: Digestive System and Nutrient Absorption

- Anatomy and function of the digestive system
- Nutrient absorption and regulation of digestion

9: Endocrine System and Hormonal Regulation

- Anatomy and function of the endocrine system
- Hormonal regulation and feedback mechanisms

10: Environmental Physiology and Adaptations to Stressors

- Overview of environmental physiology
- Adaptations to different types of stressors

11: Homeostatic Imbalances and Disease States

- Overview of homeostatic imbalances and their consequences
- Common disease states and their effects on physiological systems

12: Genetic Basis of Physiology

- Overview of genetics and its role in physiology
- Genetic disorders and their impact on physiological systems

13: Exercise Physiology and Metabolic Adaptations

- Overview of exercise physiology
- Metabolic adaptations to exercise and physical activity

14: Aging and Physiological Changes

- Overview of aging and its effects on physiological systems
- Age-related diseases and their impact on health

15: Reproductive System and Hormonal Regulation

- Anatomy and function of the male and female reproductive systems
- Hormonal regulation of reproduction

16: Immunology and Inflammation

- Overview of the immune system

- Inflammation and its role in immune response

17: Pharmacology and Drug Effects on Physiology

- Overview of pharmacology and drug mechanisms
- Common drug effects on physiological systems

18: Body Composition and Energy Balance

- Overview of body composition and energy balance
- Energy expenditure and weight management

19: Circadian Rhythms and Biological Clocks

- Overview of circadian rhythms and biological clocks
- Implications for health and disease

20: Neural Control of Cardiovascular and Respiratory Systems

- Anatomy and function of neural control of cardiovascular and respiratory systems
- Regulation of blood pressure and breathing rate

21: Environmental Factors and Physiology

- Effects of environmental factors such as temperature, altitude, and pollution on physiological systems
- Adaptations to environmental stressors

22: Hormonal Control of Digestive System

- Anatomy and function of hormonal control of digestive system
- Regulation of digestion and nutrient absorption

23: Mechanisms of Pain and Pain Management

- Overview of pain mechanisms
- Common pain management strategies and their effects on physiology

24: Brain and Behavior

- Anatomy and function of the brain and its impact on behavior
- Effects of emotions and stress on physiological systems

25: Autonomic Nervous System and Stress Response

- Anatomy and function of the autonomic nervous system
- Stress response and its effects on physiological systems

26: Reproductive Health and Fertility

- Overview of reproductive health
- Common issues affecting fertility and their impact on physiological systems

27: Physiology of Sleep and Sleep Disorders

- Anatomy and function of sleep
- Common sleep disorders and their effects on health

Practical class:

1: Introduction to Lab Techniques in Physiology
- Introduction to lab safety protocols
- Overview of lab equipment and materials
- Basic lab skills (pipetting, measuring, weighing, etc.)
- Data analysis and interpretation

2: Physiology of Muscle Contraction
- Isolation and preparation of muscle tissue (e.g., frog gastrocnemius)
- Stimulation of muscle contraction using electrical stimulation
- Measurement of muscle force and contraction velocity
- Analysis of muscle fatigue

3: Cardiovascular Physiology
- Measurement of blood pressure using sphygmomanometer
- ECG measurement and analysis
- Calculation of cardiac output and stroke volume
- Effects of exercise on cardiovascular function

4: Respiratory Physiology
- Measurement of lung volumes and capacities using spirometer
- Analysis of respiratory flow rates
- Calculation of respiratory rate and minute ventilation
- Effects of different respiratory stimuli on ventilation

5: Endocrine System Physiology
- Measurement of blood glucose levels using glucometer
- Analysis of hormone levels (e.g., cortisol, insulin) using ELISA
- Calculation of metabolic rate and energy expenditure
- Effects of hormones on metabolic processes

6: Digestive System Physiology
- Measurement of gastric acid secretion using pH meter
- Analysis of nutrient absorption using spectrophotometer
- Calculation of energy intake and expenditure
- Effects of diet on digestive processes

7: Renal Physiology
- Measurement of urine volume and composition
- Calculation of glomerular filtration rate (GFR)
- Analysis of renal function using biochemical markers (e.g., creatinine)
- Effects of dehydration on renal function

8: Neural Control of Physiology
- Measurement of nerve conduction velocity using nerve stimulator
- Analysis of reflex responses (e.g., knee-jerk reflex)
- Calculation of nerve impulse propagation speed
- Effects of nerve damage on physiological function

9: Sensory Physiology
- Measurement of sensory thresholds using psychophysical methods
- Analysis of sensory adaptation
- Calculation of sensory acuity
- Effects of sensory deprivation on physiological function

10: Immunology and Inflammation
- Measurement of white blood cell count using hemocytometer
- Analysis of inflammatory markers (e.g., CRP) using ELISA
- Calculation of immune cell function (e.g., phagocytosis)
- Effects of immune dysfunction on physiological function

11: Environmental Physiology
- Measurement of core body temperature using thermometer
- Analysis of response to different environmental stressors (e.g., heat, cold)

- Calculation of physiological adaptations to environmental stress
- Effects of environmental stress on physiological function

12: Aging and Physiology

- Measurement of physiological parameters associated with aging (e.g., muscle strength, bone density)
- Analysis of age-related changes in physiological function
- Calculation of age-related changes in metabolic rate and energy expenditure
- Effects of age-related diseases on physiological function

13: Reproductive Physiology

- Measurement of hormone levels associated with reproductive function (e.g., FSH, LH)
- Analysis of reproductive cycles using ultrasonography
- Calculation of semen analysis parameters (e.g., sperm count, motility)
- Effects of reproductive dysfunction on physiological function

14: Pain Physiology

- Measurement of pain thresholds using psychophysical methods
- Analysis of pain modulation mechanisms
- Calculation of pain intensity and duration
- Effects of pain on physiological function

15.Measurement of Blood Pressure and Heart Rate:

- Demonstrate proper technique for taking blood pressure and heart rate measurements using a sphygmomanometer and stethoscope.
- Interpret blood pressure and heart rate readings accurately and understand the implications for cardiovascular physiology.
- Identify factors that can affect blood pressure and heart rate measurements, such as exercise, stress, and medications.
- Compare and contrast different methods for measuring blood pressure and heart rate, such as automated blood pressure monitors and heart rate monitors.

16.Measurement of Lung Function:

- Demonstrate proper technique for measuring lung function using a spirometer.

- Interpret lung function measurements accurately and understand the implications for respiratory physiology.
- Identify factors that can affect lung function measurements, such as age, smoking, and lung disease.
- Compare and contrast different methods for measuring lung function, such as peak expiratory flow rate (PEFR) and forced vital capacity (FVC).

17.Analysis of Electrocardiogram (ECG) Waveforms:

- Identify and interpret the different components of an ECG waveform, such as the P wave, QRS complex, and T wave.
- Recognize normal and abnormal ECG waveforms and understand the implications for cardiac physiology.
- Understand the physiological mechanisms that generate the ECG waveform and how they relate to cardiac function.
- Compare and contrast different methods for analyzing ECG waveforms, such as Holter monitoring and exercise stress testing.

18.Analysis of Muscle Function:

- Demonstrate proper technique for analyzing muscle function using techniques such as EMG and force plate analysis.
- Interpret muscle function measurements accurately and understand the implications for musculoskeletal physiology.
- Identify factors that can affect muscle function measurements, such as age, exercise, and injury.
- Compare and contrast different methods for analyzing muscle function, such as isokinetic testing and muscle biopsies.

19.Analysis of Brain Function:

- Demonstrate proper technique for analyzing brain function using techniques such as EEG and fMRI.
- Interpret brain function measurements accurately and understand the implications for neural physiology.
- Identify factors that can affect brain function measurements, such as age, sex, and disease.
- Compare and contrast different methods for analyzing brain function, such as magnetoencephalography (MEG) and transcranial magnetic stimulation (TMS).

20.Measurement of Body Composition:

- Demonstrate proper technique for measuring body composition using techniques such as BIA and DXA.
- Interpret body composition measurements accurately and understand the implications for metabolic physiology.
- Identify factors that can affect body composition measurements, such as age, sex, and exercise.
- Compare and contrast different methods for measuring body composition, such as skinfold measurements and air displacement plethysmography.

21.Analysis of Circadian Rhythms:

- Demonstrate proper technique for analyzing circadian rhythms using techniques such as melatonin assays and act

22.Thermoregulation Experiments:

- Describe the physiological mechanisms that regulate thermoregulation.
- Demonstrate the proper technique for measuring core body temperature, skin temperature, and sweat rate in response to different environmental conditions.
- Analyze the results of thermoregulation experiments and interpret the implications for maintaining homeostasis.
- Discuss the importance of thermoregulation in human physiology and health.

23.Reproductive Physiology Experiments:

- Explain the physiological mechanisms that regulate reproductive function in both males and females.
- Demonstrate the proper technique for measuring menstrual cycle parameters, sperm motility, and fertility markers.
- Analyze the results of reproductive physiology experiments and interpret the implications for fertility and reproduction.
- Discuss the importance of reproductive physiology in human health and reproduction.

24.Immune System Experiments:

- Describe the different components and functions of the immune system.

- Demonstrate the proper technique for measuring white blood cell counts, antibody levels, and cytokine production.
- Analyze the results of immune system experiments and interpret the implications for fighting infection and disease.
- Discuss the importance of the immune system in maintaining overall health and preventing illness.

References:

1. Silverthorn, Dee Unglaub. Human Physiology: An Integrated Approach. 7th ed., Pearson Education Limited, 2015.
2. Hall, John E. Guyton and Hall Textbook of Medical Physiology. 14th ed., Elsevier, 2021.

5	Course title: Lab Management and Medical Informatics	Course Code: LBMT-202

Overall Description and Aims:

The Course is designed to equip students with the necessary skills and knowledge to effectively manage and maintain medical laboratories, as well as to apply medical informatics to enhance patient care. This course covers a range of topics including laboratory operations, quality assurance, regulatory compliance, data management, and medical informatics. By using a combination of lectures, case studies, and hands-on exercises, students will gain a comprehensive understanding of laboratory management, regulatory compliance, data management, and medical informatics. Ultimately, the course aims to prepare students to manage modern medical laboratories and apply medical informatics to improve patient care.

Intended Learning Outcomes of the Course:

Upon completion of the course, students should be able to demonstrate the following:

Knowledge and Understanding:

- Understand the fundamental principles of laboratory operations and management.
- Understand the regulatory requirements governing laboratory operations and compliance.
- Understand the principles of quality assurance and quality control in laboratory operations.
- Understand the importance of data management and medical informatics in modern healthcare.

Intellectual Skills:

- Analyze and evaluate laboratory operations to identify areas for improvement.
- Evaluate and apply laboratory regulations and compliance requirements to ensure laboratory operations meet the necessary standards.
- Develop and implement quality control measures to ensure accurate and reliable laboratory results.
- Analyze and interpret medical data to provide valuable insights for patient care.

Professional and Practical Skills:

- Develop laboratory policies and procedures to ensure effective and efficient laboratory operations.
- Develop and implement data management and medical informatics strategies to improve patient care.
- Effectively communicate laboratory findings and medical information to healthcare professionals and patients.
- Implement strategies to ensure laboratory safety and compliance.

General Transferable Skills:

- Develop problem-solving skills and critical thinking skills.
- Develop communication skills for effective communication with healthcare professionals and patients.
- Develop skills for managing and leading laboratory staff.

Course topics:

1: Introduction to Laboratory Operations and Management
- Laboratory organization and structure
- Types of laboratories and their functions
- The role of laboratory personnel
- Laboratory documentation and record keeping

2: Laboratory Regulations and Compliance
- 2.1 Overview of laboratory regulations and guidelines
- 2.2 The role of regulatory bodies
- 2.3 Compliance strategies and best practices
- 2.4 Documentation and reporting requirements

3: Quality Assurance and Quality Control in Laboratory Operations
    - The principles of quality assurance and quality control
    - Quality management systems in the laboratory
    - Validation and verification of laboratory methods
    - Quality metrics and performance indicators

4: Laboratory Information Management Systems
    - Introduction to laboratory information management systems (LIMS)
    - Features and capabilities of LIMS

- Implementation and integration of LIMS in laboratory operations
- Data security and confidentiality in LIMS

5: Medical Informatics

- Introduction to medical informatics
- Electronic health records (EHR) and their use in healthcare
- Clinical decision support systems (CDSS)
- Telemedicine and telehealth applications

6: Laboratory Equipment Management and Maintenance

- Equipment selection and procurement
- Calibration and maintenance of laboratory equipment
- Troubleshooting equipment problems
- Replacement and retirement of laboratory equipment

7: Laboratory Safety and Compliance

- Introduction to laboratory safety
- Hazards and risks in the laboratory
- Safety equipment and procedures
- Emergency response and incident management

8: Laboratory Accreditation and Certification

- Overview of laboratory accreditation and certification programs
- The benefits of accreditation and certification
- The accreditation and certification process
- Maintaining accreditation and certification

9: Laboratory Budgeting and Finance

- Budget development and management
- Cost analysis and resource allocation
- Revenue generation and funding opportunities
- Financial reporting and accountability

10: Laboratory Auditing and Inspection

- Types of laboratory audits and inspections
- Audit and inspection planning and preparation
- Audit and inspection execution and follow-up
- Corrective action and continuous improvement

11: Laboratory Project Management

- The principles of project management
- Project planning and scheduling
- Resource allocation and budgeting for projects
- Project monitoring and evaluation

12: Laboratory Ethics and Professionalism

- The role of ethics in laboratory operations
- Ethical issues in laboratory research and development
- Professional conduct and responsibility
- Confidentiality and data security

13: Data Analysis and Reporting

- Data collection and management
- Statistical analysis and interpretation of data
- Data visualization and reporting
- Data sharing and publication ethics

14: Medical Informatics Applications in Healthcare

- Clinical decision support systems (CDSS) in healthcare
- Health information exchange (HIE) systems
- Patient engagement and empowerment through health informatics
- Health data analytics and population health management

15: Leadership and Team Management in the Laboratory

- Leadership styles and approaches
- Team building and communication skills
- Conflict resolution and problem-solving
- Performance management and evaluation

16: Laboratory Waste Management

- Define laboratory waste management and its importance in laboratory operations.
- Discuss the regulations and guidelines for laboratory waste management.
- Evaluate the effectiveness of laboratory waste management strategies.
- Develop and implement a laboratory waste management plan.

17: Laboratory Personnel Management

- Define laboratory personnel management and its importance in laboratory operations.
- Discuss the challenges and best practices for laboratory personnel management.
- Evaluate the effectiveness of laboratory personnel management strategies.
- Develop and implement a laboratory personnel management plan.

18: Laboratory Inventory Control

- Define laboratory inventory control and its importance in laboratory operations.
- Discuss the methods and best practices for laboratory inventory control.
- Evaluate the effectiveness of laboratory inventory control strategies.
- Develop and implement a laboratory inventory control plan.

19: Laboratory Informatics and Analytics

- Define laboratory informatics and analytics and their importance in laboratory operations.
- Discuss the use of informatics and analytics for laboratory data management and analysis.
- Evaluate the effectiveness of laboratory informatics and analytics tools.
- Develop and implement laboratory informatics and analytics solutions.

20: Laboratory Automation and Robotics

- Define laboratory automation and robotics and their importance in laboratory operations.
- Discuss the benefits and challenges of laboratory automation and robotics.
- Evaluate the effectiveness of laboratory automation and robotics systems.
- Develop and implement laboratory automation and robotics solutions.

Practical Classes:

1: Laboratory Safety and Compliance Training: Students will be able to identify potential laboratory hazards and develop safety protocols to minimize the risk of accidents.

2: Quality Control Procedures: Students will be able to perform and interpret quality control tests to ensure accuracy and precision in laboratory results.

3: Laboratory Equipment Maintenance: Students will be able to perform routine maintenance tasks and troubleshoot common issues with laboratory equipment.

4: Laboratory Data Analysis: Students will be able to analyze and interpret laboratory data using statistical methods.

5: Laboratory Information System Integration: Students will be able to implement laboratory information system integration to improve efficiency and data accuracy in laboratory operations.

6: Laboratory Waste Management: Students will be able to identify and properly dispose of different types of laboratory waste.

7: Personnel Management: Students will be able to apply best practices in laboratory personnel management, including hiring, training, and performance evaluations.

8: Inventory Control: Students will be able to develop and implement an effective laboratory inventory control system.

9: Informatics and Analytics: Students will be able to use laboratory informatics and analytics tools to manage and analyze laboratory data.

10: Automation and Robotics: Students will be able to operate and troubleshoot laboratory automation and robotics systems.

References:

1. Valenstein PN. Laboratory management principles and processes. 3rd ed. Washington: American Society for Clinical Pathology Press; 2017.
2. O'Connor J. Laboratory waste management: a guidebook. London: Royal Society of Chemistry; 2018.
3. Jha AK, DesRoches CM, Campbell EG, Donelan K, Rao SR, Ferris TG, et al. Use of electronic health records in U.S. hospitals. N Engl J Med. 2009;360(16):1628-38.

6	Course title: Medical Immunology	Course Code: MLSC-205

Overall Description and Aims:

The course aims to provide students with a comprehensive understanding of the immune system, its mechanisms, functions, and clinical applications. The course intends to equip students with knowledge and skills to enable them to pursue careers in biomedical sciences, immunology research, and clinical practice. The course aims to develop students' ability to think critically and analytically, communicate effectively, and work collaboratively in a team.

Intended Learning Outcomes:

Knowledge and Understanding:

1. Describe the components, organization, and functions of the immune system
2. Explain the molecular basis of immune recognition and response
3. Discuss the role of immune system in health and disease
4. Describe the genetic, ontogenic, and clinical implications of immune system function

Intellectual Skills:

1. Analyze and interpret immunological data and literature
2. Evaluate the contribution of immune system in disease pathogenesis
3. Design and execute immunological experiments
4. Develop critical thinking and problem-solving skills

Professional and Practical Skills:

1. Communicate effectively about immunological concepts and findings
2. Work collaboratively in a team
3. Develop laboratory skills and techniques in immunological research
4. Demonstrate ethical and professional behavior in biomedical sciences

General Transferable Skills:

1. Develop effective written and oral communication skills
2. Enhance time-management and organization skills

3. Develop computer literacy and data analysis skills
4. Develop leadership and team management skills

1: Introduction

- The historical evolution of immunology as a scientific discipline
- The basic principles and terminology of immunology
- The role of immunology in health and disease research

2: Leucocytes and Lymphoid Tissues: The Framework of the Immune System

- Classification and differentiation of leukocytes
- The anatomy and functions of lymphoid tissues and organs
- Leukocyte trafficking and migration in the immune system

Chapter 3: Major Histocompatibility Complex

- The structure and organization of MHC molecules
- MHC class I and class II molecules and their roles in antigen presentation
- MHC polymorphism and its clinical implications

4: The Adaptive Immune Response: Antigens, Lymphocytes and Accessory Cells

- The structure and diversity of antigens
- The differentiation and maturation of B and T lymphocytes
- The roles of accessory cells in the adaptive immune response

Chapter 5: Immunoglobulins: Structure and Diversity

- The structure and properties of immunoglobulins
- The diversity of immunoglobulin genes and proteins
- The role of immunoglobulins in immune defense

6: Immunoglobulins: Metabolism and Biological Properties

- The metabolism and catabolism of immunoglobulins
- The biological functions of immunoglobulins

- The clinical implications of immunoglobulin abnormalities

7: Genetics of Immunoglobulins: Ontogenic, Biological and Clinical Implications

- The genetics of immunoglobulin production
- The ontogeny of immunoglobulin production and maturation
- The clinical implications of immunoglobulin gene mutations

8: Antigen-Antibody Reactions

- The principles and mechanisms of antigen-antibody reactions
- The kinetics and specificity of antigen-antibody interactions
- The clinical applications of antigen-antibody reactions

9: The Complement System in Health and Disease

- The components and functions of the complement system
- The mechanisms of complement activation and regulation
- The clinical implications of complement deficiencies and abnormalities

10: Monocyte and Lymphocyte Membrane Markers: Ontogeny and Clinical Significance

- The structure and functions of monocyte and lymphocyte membrane markers
- The ontogeny and differentiation of monocyte and lymphocyte subsets
- The clinical applications of monocyte and lymphocyte membrane markers

11: Cell-Mediated Immunity

- The structure and functions of T lymphocytes
- The mechanisms of T cell activation and differentiation
- The clinical implications of T cell abnormalities

12: Adaptive Humoral Immunity and Immunoprophylaxis

- The principles and mechanisms of humoral immune responses
- The clinical applications of immunoprophylaxis
- The role of immunization in public health

13: Phagocytic Cells and their Functions

- The structure and functions of phagocytic cells
- The mechanisms of phagocytosis and microbial killing
- The clinical implications of phagocytic cell abnormalities

14: Anti-Infectious Innate and Adaptive Immune Responses

- The mechanisms and components of innate immune responses to infections
- The mechanisms and components of adaptive immune responses to infections
- The clinical implications of immune responses to infections

15: Diagnostic Applications of Immunology

- The principles and techniques of immunological diagnostic tests
- The clinical applications of serological tests

16: Tolerance and Autoimmunity

- Mechanisms of immune tolerance induction
- Self-reactive lymphocyte selection
- Central and peripheral tolerance

17: Organ-Specific Autoimmune Diseases

- Pathogenesis of autoimmune diseases affecting organs such as thyroid, pancreas, and liver
- Diagnosis and treatment of organ-specific autoimmune diseases
- Current research on the underlying mechanisms of organ-specific autoimmune diseases

18: Systemic Lupus Erythematosus

- Clinical presentation and diagnosis of systemic lupus erythematosus (SLE)
- Pathogenesis of SLE, including genetic and environmental factors
- Treatment options for SLE, including immunosuppressive therapy and targeted biologic agents

19: Rheumatoid Arthritis

- Pathogenesis of rheumatoid arthritis (RA), including genetic and environmental factors
- Clinical presentation and diagnosis of RA

- Treatment options for RA, including nonsteroidal anti-inflammatory drugs (NSAIDs), disease-modifying antirheumatic drugs (DMARDs), and biologic agents

20: Overview of Hypersensitivity

- Types of hypersensitivity reactions (Type I-IV)
- Mechanisms underlying different types of hypersensitivity reactions
- Clinical manifestations and treatment options for hypersensitivity reactions

21: IgE-mediated (Immediate) Hypersensitivity

- Pathogenesis and clinical manifestations of IgE-mediated hypersensitivity
- Diagnosis of IgE-mediated hypersensitivity, including skin testing and in vitro assays
- Treatment options for IgE-mediated hypersensitivity, including avoidance of allergens and immunotherapy

22: Immunohematology

- Blood groups and their clinical significance
- Mechanisms of blood transfusion reactions
- Clinical laboratory techniques for blood typing and crossmatching

23: The Pathogenic Role of Antigen-Antibody Complexes

- Mechanisms of immune complex formation
- Pathogenic consequences of immune complex deposition
- Relationship between immune complex deposition and autoimmune diseases

24: Immune System Modulators

- Pharmacological agents that modulate the immune system, such as corticosteroids and immunosuppressive drugs
- Mechanisms of action of immune system modulators
- Side effects and potential complications of immune system modulators

25: Transplantation Immunology

- Types of organ and tissue transplantation
- Mechanisms of graft rejection

- Strategies to prevent and treat graft rejection, including immunosuppressive drugs and tolerance induction

26: Tumor Immunology

- Immunological mechanisms underlying tumor development and progression
- Approaches to cancer immunotherapy, including checkpoint inhibitors and CAR-T cell therapy
- Challenges and limitations of cancer immunotherapy

27: Lymphocyte and Plasma Cell malignancies

- Classification and clinical characteristics of lymphocyte and plasma cell malignancies, such as leukemia, lymphoma, and myeloma
- Diagnostic methods for lymphocyte and plasma cell malignancies, including flow cytometry and molecular testing
- Treatment options for lymphocyte and plasma cell malignancies, including chemotherapy and immunotherapy

28: Diagnosis of Immune Deficiency Diseases

- Different types of immune deficiency diseases, including primary and secondary immunodeficiencies
- Diagnostic criteria and laboratory testing for immune deficiency diseases
- Treatment options for immune deficiency diseases, including immunoglobulin replacement therapy and bone marrow transplantation

29: Primary Immunodeficiency Diseases

- Inherited primary immunodeficiency diseases, such as severe combined immunodeficiency (SCID) and common variable immunodeficiency (CVID)
- Clinical manifestations and diagnostic criteria for primary immunodeficiency diseases
- Current research on novel therapies for primary immunodeficiency diseases

30: AIDS and Other Acquired Immunodeficiencies

- Pathogenesis of HIV and AIDS
- Clinical manifestations and diagnosis of AIDS
- Treatment and prevention of AIDS and other acquired immunodeficiencies

Practical Classes:

1. Microscopy Techniques in Immunology
    - Objective: To learn how to prepare samples and perform immunofluorescence microscopy.
2. Flow Cytometry and Cell Sorting
    - Objective: To learn how to perform flow cytometry and analyze data.
3. ELISA and Western Blotting
    - Objective: To learn how to perform ELISA and Western blotting assays.
4. T Cell Proliferation Assay
    - Objective: To learn how to perform a T cell proliferation assay.
5. B Cell ELISPOT Assay
    - Objective: To learn how to perform a B cell ELISPOT assay.
6. Antibody Production and Purification
    - Objective: To learn how to produce and purify monoclonal antibodies.
7. Immunohistochemistry and Immunofluorescence
    - Objective: To learn how to perform immunohistochemistry and immunofluorescence techniques.
8. Tissue Culture Techniques
    - Objective: To learn how to maintain and manipulate cell lines in tissue culture.

Reference:

Virella, G. (2021). Medical Immunology, 7th Edition. CRC Press.

7	Course title: Medical Microbiology	Course Code: MLSC-206

Overall Description and Aims:

The course is designed to provide students with a comprehensive understanding of the microbes that cause infectious diseases, their pathogenesis, and their clinical management. The course will cover topics such as the structure and function of microbes, host-microbe interactions, host defense mechanisms, diagnosis and treatment of infectious diseases, and prevention of transmission. The course aims to equip students with the knowledge and skills required to pursue a career in biomedical research, public health, or clinical practice.

Intended Learning Outcomes:

Knowledge and Understanding:

- Describe the structure and function of microorganisms, including bacteria, fungi, viruses, and parasites
- Explain the mechanisms of pathogenesis and virulence of microbial infections
- Understand the principles of antimicrobial agents and resistance
- Describe the principles of immunology and immune responses to microbial infections
- Understand the principles of public health and infectious disease control
- Understand the principles of clinical microbiology and infectious disease management
- Understand the principles of microbial genetics and genomics

Intellectual Skills:

- Analyze and interpret scientific data related to infectious diseases
- Apply critical thinking to evaluate the significance of research findings
- Formulate hypotheses and design experiments to test them

Professional and Practical Skills:

- Demonstrate proficiency in basic microbiological techniques, such as culturing and identifying microbes

- Apply the principles of infection control and prevention in clinical and research settings
- Communicate scientific information clearly and effectively to different audiences

General Transferable Skills:

- Work effectively in a team environment
- Manage time and resources effectively
- Demonstrate ethical and professional conduct

Course Topics:

1. Introduction to medical microbiology and infectious diseases Objective: Understand the scope and significance of medical microbiology
2. The microbial world: Bacteria, viruses, fungi, and parasites Objective: Understand the diversity and characteristics of microbes that cause infectious diseases
3. Microbial structure and function Objective: Understand the structure and function of microbial cells
4. Microbial growth and control Objective: Understand the principles of microbial growth and control
5. Host-microbe interactions Objective: Understand the interactions between microbes and their hosts
6. Host defense mechanisms Objective: Understand the mechanisms of host defense against infectious agents
7. Laboratory diagnosis of infectious diseases Objective: Understand the principles of laboratory diagnosis of infectious diseases
8. Antimicrobial agents and chemotherapy Objective: Understand the principles of antimicrobial agents and their clinical use
9. Mechanisms of bacterial pathogenesis Objective: Understand the mechanisms of bacterial pathogenesis
10. Mechanisms of viral pathogenesis Objective: Understand the mechanisms of viral pathogenesis
11. Mechanisms of fungal and parasitic pathogenesis Objective: Understand the mechanisms of fungal and parasitic pathogenesis
12. Epidemiology and transmission of infectious diseases Objective: Understand the principles of epidemiology and transmission of infectious diseases
13. Immunization and vaccination Objective: Understand the principles of immunization and vaccination

14. Respiratory infections Objective: Understand the pathogenesis, diagnosis, and treatment of respiratory infections
15. Gastrointestinal infections Objective: Understand the pathogenesis, diagnosis, and treatment of gastrointestinal infections
16. Genitourinary infections Objective: Understand the pathogenesis, diagnosis, and treatment of genitourinary infections
17. Skin and soft tissue infections Objective: Understand the pathogenesis, diagnosis, and treatment of skin and soft tissue infections
18. Systemic infections Objective: Understand the pathogenesis, diagnosis, and treatment of systemic infections
19. Sexually transmitted infections Objective: Understand the pathogenesis, diagnosis, and treatment of sexually transmitted infections
20. Opportunistic infections Objective: Understand the pathogenesis, diagnosis, and treatment of opportunistic infections
21. Antibiotic resistance and stewardship Objective: Understand the principles of antibiotic resistance and stewardship
22. Emerging and re-emerging infectious diseases Objective: Understand the principles of emerging and re-emerging infectious diseases
23. Public health Objective: Understand the principles of public health and infectious disease control

24. Clinical microbiology and infectious disease management Objective: Understand the principles of clinical microbiology and infectious disease management
25. Infection control and prevention Objective: Understand the principles of infection control and prevention in clinical and research settings
26. Microbial genetics and genomics Objective: Understand the principles of microbial genetics and genomics
27. Bioinformatics and data analysis in medical microbiology Objective: Understand the principles of bioinformatics and data analysis in medical microbiology
28. Research methods in medical microbiology Objective: Understand the principles of research methods in medical microbiology

Practical classes:

1. Microscopy techniques for the observation of microorganisms.
2. Staining techniques
3. Isolation and identification of common bacterial pathogens.
4. Culturing techniques for viruses and parasites
5. Antimicrobial susceptibility testing.
6. Sterilization and disinfection techniques.
7. Serological techniques for the diagnosis of infectious diseases.
8. Molecular techniques for the detection of microbial pathogens.
9. Bacterial culture techniques for the diagnosis of tuberculosis.
10. Fungal culture and identification techniques.
11. Parasitological techniques for the diagnosis of intestinal parasites.
12. Diagnosis of sexually transmitted infections.
13. Diagnosis of viral infections.
14. Laboratory diagnosis of zoonotic infections.
15. Microbial identification using commercial systems.
16. Laboratory quality control and quality assurance.
17. Biosafety and biosecurity practices in the laboratory.
18. Critical analysis of laboratory results and interpretation of findings.

References:

1. Murray, P. R., Rosenthal, K. S., & Pfaller, M. A. (2019). Medical microbiology. Elsevier Health Sciences.
2. Wessner, D. R., Dupont, C., & Charles, T. C. (2019). Global health: an introduction to current and future trends. John Wiley & Sons.

8	Course title: Molecular Biology Techniques	Course Code: MOLD-204

Overall Description and Aims:

The course provides students with theoretical and practical knowledge of molecular biology techniques used in research and clinical settings. The course covers essential molecular biology techniques, including DNA extraction, PCR, cloning, gene expression analysis, and DNA sequencing. The course aims to develop students' practical skills in molecular biology and prepare them for research and clinical careers.

Intended Learning Outcomes of Course:

Knowledge and Understanding:

1. Understand the fundamental concepts and principles of molecular biology.
2. Understand the theoretical basis of essential molecular biology techniques.
3. Understand the role of molecular biology techniques in research and clinical settings.

Intellectual Skills:

1. Analyze scientific literature related to molecular biology techniques.
2. Design experiments and optimize protocols for molecular biology techniques.
3. Interpret data generated from molecular biology experiments.

Professional and Practical Skills:

1. Demonstrate practical skills in molecular biology techniques.
2. Perform experiments and record data accurately and precisely.
3. Work collaboratively in a laboratory setting.

General Transferable Skills:

1. Communicate scientific ideas and results effectively.
2. Solve problems and think critically.
3. Manage time effectively.

Course Topics:

1. Introduction to molecular biology techniques

- Define molecular biology and its significance in research and clinical settings.
- Understand the historical context of molecular biology.
- Describe the central dogma of molecular biology.

2. DNA Extraction
   - Understand the basic principles of DNA extraction.
   - Describe different DNA extraction methods.
   - Optimize DNA extraction protocols.
3. Polymerase Chain Reaction (PCR)
   - Understand the basic principles of PCR.
   - Describe the different types of PCR.
   - Optimize PCR protocols.
4. Gel Electrophoresis
   - Understand the basic principles of gel electrophoresis.
   - Describe different types of gel electrophoresis.
   - Analyze gel electrophoresis results.
5. Cloning
   - Understand the basic principles of cloning.
   - Describe different types of cloning.
   - Optimize cloning protocols.
6. Gene Expression Analysis
   - Understand the basic principles of gene expression analysis.
   - Describe different methods of gene expression analysis.
   - Analyze gene expression data.
7. Western Blotting
   - Understand the basic principles of Western blotting.
   - Describe the different steps involved in Western blotting.
   - Analyze Western blotting results.
8. Enzyme-Linked Immunosorbent Assay (ELISA)
   - Understand the basic principles of ELISA.
   - Describe the different types of ELISA.
   - Optimize ELISA protocols.
9. DNA Sequencing
   - Understand the basic principles of DNA sequencing.
   - Describe different types of DNA sequencing.
   - Analyze DNA sequencing data.
10. Restriction Enzyme Digestion
    - Understand the basic principles of restriction enzyme digestion.
    - Describe different types of restriction enzymes.
    - Optimize restriction enzyme digestion protocols.

11. Site-Directed Mutagenesis
    - Understand the basic principles of site-directed mutagenesis.
    - Describe different types of site-directed mutagenesis.
    - Optimize site-directed mutagenesis protocols.
12. RNA Extraction and Analysis
    - Understand the basic principles of RNA extraction and analysis.
    - Describe different RNA extraction and analysis methods.
    - Optimize RNA extraction and analysis protocols.
13. Real-Time PCR
    - Understand the basic principles of real-time PCR.
    - Describe different types of real-time PCR.
    - Optimize real-time PCR protocols.
14. Microarray Analysis
    - Understand the basic principles of microarray analysis.
    - Describe different types of microarray analysis.

15: Epigenetic Modifications:

- The role of epigenetic modifications in gene expression
- Different modifications affect chromatin structure and function.

16: Recombinant Protein Production:

- Principles and techniques of recombinant protein production
- The use of expression vectors and host cells

17: Genome Editing Objective:

- the principles and applications of genome editing technologies
- CRISPR-Cas9.

18: RNA Interference (RNAi):

- Principles and applications of RNAi technology
- The use of siRNA and shRNA

19: Stem Cell Culture and Differentiation:

- Principles and techniques of stem cell culture and differentiation

Practical Classes:

1. Introduction to basic laboratory techniques:

- To introduce students to the basic laboratory techniques and safety protocols used in molecular biology experiments.

2. Gel electrophoresis:

- Perform and analyze gel electrophoresis experiments, including DNA and protein gel electrophoresis.

3. Restriction enzyme digestion and ligation:

- Perform and analyze restriction enzyme digestion and ligation experiments, including plasmid preparation and purification.

4. Polymerase chain reaction (PCR):

- Perform and analyze PCR experiments, including primer design, optimization of reaction conditions,

5: DNA Sequencing:

- Understand the principles and applications of DNA sequencing
- Learn the different DNA sequencing methods and their advantages and disadvantages
- Be able to perform basic DNA sequencing experiments

6: Polymerase Chain Reaction (PCR):

- Understand the principles and applications of PCR
- Learn the different types of PCR and their advantages and disadvantages
- Be able to perform basic PCR experiments

7: Gene Expression Analysis:

- Understand the principles and applications of gene expression analysis
- Learn the different methods for measuring gene expression and their advantages and disadvantages
- Be able to perform basic gene expression experiments

8: Protein Purification:

- Understand the principles and applications of protein purification
- Learn the different protein purification techniques and their advantages and disadvantages
- Be able to perform basic protein purification experiments

9 Enzyme Kinetics:

- Understand the principles and applications of enzyme kinetics
- Learn the different methods for measuring enzyme activity and their advantages and disadvantages
- Be able to perform basic enzyme kinetics experiments

10: Western Blotting:

- Understand the principles and applications of western blotting
- Learn the different western blotting techniques and their advantages and disadvantages
- Be able to perform basic western blotting experiments

11: Immunoprecipitation:

- Understand the principles and applications of immunoprecipitation
- Learn the different immunoprecipitation techniques and their advantages and disadvantages
- Be able to perform basic immunoprecipitation experiments

12: Flow Cytometry:

- Understand the principles and applications of flow cytometry
- Learn the different flow cytometry techniques and their advantages and disadvantages
- Be able to perform basic flow cytometry experiments

13: Microscopy:

- Understand the principles and applications of microscopy
- Learn the different types of microscopy and their advantages and disadvantages
- Be able to perform basic microscopy experiments

14: Bioinformatics:

- Understand the principles and applications of bioinformatics
- Learn the different bioinformatics tools and their advantages and disadvantages
- Be able to perform basic bioinformatics analyses

References:

1. Molecular Biology Techniques: A Classroom Laboratory Manual, 4th Edition, by Susan Carson, Heather Miller, and D. Scott Witherow (2018).
2. Molecular Biology: Principles and Practice, 3rd Edition, by Michael M. Cox, Jennifer Doudna, and Michael O'Donnell (2021).

9	Course title: Principles of Human Genetics	Course Code: MOLD-205

Overall Description and Aims:

The Principles of Human Genetics undergraduate course in Biomedical Sciences aims to provide students with a comprehensive understanding of the fundamental principles of human genetics and their applications in various fields of medicine and healthcare. The course will cover the basic concepts of genetics, including inheritance patterns, molecular genetics, gene expression, and genomics, and how these principles apply to human health and disease. The course will also cover ethical, legal, and social issues related to human genetics and genomics.

Intended Learning Outcomes:

Upon completing the course, students will be able to:

- Demonstrate a solid understanding of the fundamental principles of human genetics
- Analyze and interpret genetic data using molecular genetic techniques
- Apply genetic principles to the diagnosis and treatment of human diseases
- Understand the ethical, legal, and social issues related to human genetics and genomics
- Develop critical thinking, problem-solving, and analytical skills
- Develop professional and practical skills necessary for a career in the biomedical sciences
- Develop general transferable skills such as communication, teamwork, and time management.

Knowledge and Understanding:

- Basic principles of genetics
- Molecular genetics and gene expression
- Genomics and personalized medicine
- Genetic diseases and their inheritance patterns
- Genetic testing and counseling
- Ethical, legal, and social issues related to human genetics and genomics

Intellectual Skills:

- Analyzing genetic data using molecular genetic techniques
- Applying genetic principles to the diagnosis and treatment of human diseases

- Critically evaluating research studies in human genetics
- Synthesizing and interpreting complex genetic information
- Developing hypotheses and designing experiments in genetics research

Professional and Practical Skills:

- Genetic counseling and communication skills
- Designing and implementing genetic tests
- Interpreting and reporting genetic test results
- Performing molecular genetic techniques
- Analyzing and interpreting genetic data using bioinformatics tools

General Transferable Skills:

- Communication skills
- Teamwork and collaboration
- Time management and organization
- Critical thinking and problem-solving
- Adaptability and flexibility

Course topics:

1. Introduction to Human Genetics

- Basic genetics terminology
- Historical development of human genetics
- Human genome and genetic variation

2. History of Human Genetics

- Early theories of inheritance
- Discovery of DNA and its role in genetics
- Landmark discoveries in human genetics

3. Structure and Function of DNA

- Chemical structure of DNA
- DNA replication and repair
- DNA transcription and translation

4. Chromosome Structure and Function

- Chromosome organization and morphology
- Chromosome segregation and meiosis
- Chromosome abnormalities and human disease

5. Mendelian Genetics

- Mendel's laws of inheritance
- Punnett squares and probability calculations
- Inheritance patterns and genetic variation

6. Pedigree Analysis

- Pedigree construction and interpretation
- Autosomal dominant and recessive inheritance
- X-linked inheritance and sex-linked traits

7. Single Gene Disorders

- Cystic fibrosis and other recessive disorders
- Huntington's disease and other dominant disorders
- Sickle cell anemia and other codominant disorders

8. Chromosomal Disorders

- Down syndrome and other trisomies
- Turner syndrome and other monosomies
- Structural chromosomal abnormalities and human disease

9. Carrier Testing

- Carrier frequency and population screening
- Genetic counseling and informed consent
- Ethics and social implications of carrier testing

11. Molecular Genetics

- DNA sequencing and genotyping
- Polymerase chain reaction (PCR) and its applications
- DNA microarrays and their uses

12. Gene Expression

- Transcription and translation
- Post-transcriptional and post-translational modifications
- Regulation of gene expression

13. Gene Regulation

- Transcriptional regulation and transcription factors
- Epigenetic regulation and chromatin modifications
- Non-coding RNA and gene regulation

14. Epigenetics

- DNA methylation and demethylation
- Histone modifications and chromatin remodeling
- Epigenetic inheritance and disease

15. Genomics

- Genome sequencing and annotation
- Comparative genomics and evolutionary genomics
- Functional genomics and systems biology

16. Human Genome Project

- Goals and objectives of the Human Genome Project
- Impact of the Human Genome Project on science and medicine
- Ethical and social implications of genome research

17. Genetic Discrimination

- Definition and examples of genetic discrimination
- Legal and ethical issues surrounding genetic discrimination
- Prevention and regulation of genetic discrimination

18. Personalized Medicine

- Definition and principles of personalized medicine
- Examples of personalized medicine in practice
- Challenges and opportunities of personalized medicine

19. Precision Medicine

- Definition and principles of precision medicine
- Role of genomics in precision medicine
- Applications of precision medicine in disease prevention and treatment

20. Pharmacogenetics

- Definition and principles of pharmacogenetics
- Examples of pharmacogenetics in practice
- Role of pharmacogenetics in drug development and precision medicine

21. Genetic Diversity

- Definition and measurement of genetic diversity
- Importance of genetic diversity in human populations
- Factors influencing genetic diversity

22. Gene-Environment Interactions

- Definition and examples of gene-environment interactions
- Mechanisms of gene-environment interactions
- Implications of gene-environment interactions for human health and disease.

Practical classes:

1. Chromosome Structure and Function

- Preparation of chromosome spreads from cells
- Staining of chromosomes for visualization
- Identification and labeling of specific chromosome structures (e.g. centromeres, telomeres)
- Analysis of chromosome number and structure abnormalities

2. Mendelian Genetics

- Cross-breeding experiments using model organisms (e.g. fruit flies, pea plants)
- Analysis of progeny to determine the mode of inheritance (e.g. dominant, recessive)
- Calculation of expected and observed ratios using Punnett squares
- Identification of phenotype and genotype frequencies

3. Pedigree Analysis

- Analysis of family pedigrees to determine patterns of inheritance
- Identification of carriers and affected individuals
- Calculation of risk for offspring to inherit a genetic disorder
- Interpretation of complex pedigrees with multiple generations and affected individuals

4. Single Gene Disorders

- Extraction and analysis of DNA from patient samples
- Identification of disease-causing mutations using PCR and sequencing techniques
- Comparison of mutant and wild-type DNA sequences
- Analysis of the effect of mutations on protein function

5. Chromosomal Disorders

- Analysis of karyotypes from patient samples
- Identification of chromosomal abnormalities (e.g. deletions, translocations)
- Calculation of the risk for offspring to inherit a chromosomal disorder
- Interpretation of complex karyotypes with multiple abnormalities

6. Genetic Testing

- Analysis of patient samples for genetic mutations associated with specific diseases
- Comparison of patient DNA with reference sequences
- Interpretation of test results and communication of findings to patients and their families
- Discussion of the benefits and limitations of genetic testing

7. Carrier Testing

- Analysis of DNA from individuals to determine carrier status for specific genetic disorders
- Calculation of the risk for offspring to inherit a genetic disorder from carrier parents
- Discussion of the implications of carrier status for family planning

8. Molecular Genetics

- Extraction and analysis of DNA and RNA from patient samples
- PCR amplification of specific DNA sequences
- Analysis of gene expression using microarray or RNA sequencing techniques
- Interpretation of gene expression data to understand the molecular basis of disease

9. Gene Expression

- Analysis of gene expression in model organisms
- Quantification of mRNA levels using qPCR or RNA sequencing
- Analysis of gene expression patterns during development or in response to environmental stimuli
- Interpretation of gene expression data to understand the function of specific genes

10. Gene Regulation

- Analysis of regulatory elements in DNA sequences
- Cloning of regulatory sequences into reporter plasmids
- Analysis of gene expression in response to different regulatory sequences
- Interpretation of data to understand the mechanisms of gene regulation

11. Epigenetics

- Analysis of epigenetic modifications (e.g. DNA methylation, histone modifications) in patient samples
- Comparison of epigenetic patterns between normal and diseased tissues
- Analysis of the effect of environmental factors on epigenetic modifications
- Interpretation of data to understand the role of epigenetics in disease development

12. Genetic Discrimination

- Discussion of case studies of genetic discrimination in healthcare and employment settings
- Analysis of legal and ethical implications of genetic discrimination
- Development of strategies to prevent genetic discrimination

13. Pharmacogenetics

- Analysis of genetic variants associated with drug metabolism and response

- Discussion of case studies of pharmacogenetic testing in clinical practice
- Interpretation of test results and communication of findings to patients and healthcare providers
- Development of personalized medicine strategies based on pharmacogenetic data

14. Genetic Diversity

- Analysis of genetic variation within and between populations
- Calculation of genetic diversity metrics (e.g. heterozygosity, Fst)
- Discussion of the implications of genetic diversity for disease susceptibility, drug response, and personalized medicine
- Interpretation of data to understand the evolutionary history and migration patterns of human populations

15. Gene-Environment Interactions

- Analysis of gene-environment interactions in model organisms
- Examination of the effect of environmental factors (e.g. diet, toxins) on gene expression and phenotype
- Calculation of the risk for disease development based on genetic and environmental factors
- Interpretation of data to understand the complex interplay between genetic and environmental factors in disease development

References:

1. Klug, W. S., Cummings, M. R., Spencer, C. A., Palladino, M. A. (2021). Essentials of Genetics. Pearson Education, Inc.
2. Lewin, B. (2018). Genes IX. Jones & Bartlett Learning.

Department of Molecular Diagnostics

Proposed Syllabi for all Courses in the Third Year



Prepared by

Abdelmuhsen Abusneina, PhD

March 9, 2023

Syllabus of Third Year Courses

1	Course title: Bioinformatics and Genomics	Course Code: MOLD-301

Overall Description and Aims:

the course aims to provide students with a deep understanding of the principles and practices of bioinformatics, genomics, and computational biology. This course will provide students with a solid foundation in the underlying concepts of molecular biology, genetics, and computer science, enabling them to apply this knowledge in the analysis of complex biological data. Students will also gain practical experience in the use of software tools and databases, and will develop professional and transferable skills in data analysis, interpretation, and communication.

Intended Learning Outcomes:

Knowledge and Understanding:

1. Develop a deep understanding of the molecular basis of life and the relationship between genomics, proteomics, and transcriptomics.
2. Understand the basic principles and methods of sequence alignment, gene prediction, and sequence analysis.
3. Learn to use computational techniques to analyze and interpret large datasets.
4. Learn to identify and use databases, software tools, and other resources for the analysis of biological data.

Intellectual Skills:

1. Develop critical thinking skills for the analysis of complex biological data.
2. Apply computational and statistical methods to interpret biological data.
3. Analyze complex genetic and genomic data and draw meaningful conclusions.
4. Develop the ability to identify and address biological questions using bioinformatics and genomics approaches.

Professional and Practical Skills:

1. Develop skills in the use of bioinformatics tools and databases.
2. Develop skills in the analysis and interpretation of biological data.
3. Develop skills in the communication of scientific findings.

4. Develop skills in team-based research and collaboration.

General Transferable Skills:

1. Develop skills in problem-solving, critical thinking, and data analysis.
2. Develop skills in scientific writing and communication.
3. Develop skills in team-based research and collaboration.
4. Develop skills in project management and time management.

Course Topics:

1: Introduction to Bioinformatics and Genomics.

Objective: Understand the history, scope, and applications of bioinformatics and genomics.

2: Molecular Biology and Genetics: Develop a deep understanding of the molecular basis of life, genetics, and genomics.

3: Sequence Alignment: Understand the basic principles and methods of sequence alignment.

4: Sequence Analysis: Develop skills in the analysis and interpretation of sequence data.

5: Gene Prediction: Understand the basic principles and methods of gene prediction.

6: Genome Assembly: Understand the basic principles and methods of genome assembly.

7: Comparative Genomics: Understand the basic principles and methods of comparative genomics.

8: Transcriptomics: Develop skills in the analysis and interpretation of transcriptomics data.

9: Proteomics: Develop skills in the analysis and interpretation of proteomics data.

10: Metabolomics: Develop skills in the analysis and interpretation of metabolomics data.

11: Structural Bioinformatics: Understand the basic principles and methods of structural bioinformatics.

12: Systems Biology: Understand the basic principles and methods of systems biology.

13: Genomic Variation: Understand the basic principles and methods of genomic variation analysis.

14: Epigenomics: Develop skills in the analysis and interpretation of epigenomic data.

15: Functional Genomics: Develop skills in the analysis and interpretation of functional genomic data.

16: Next-Generation Sequencing: Understand the basic principles and methods of next-generation sequencing.

17: High-Performance Computing: Develop skills in the use of high-performance computing for biological data analysis.

18: Machine Learning: Understand the basic principles and methods of machine learning and its applications in bioinformatics and genomics.

19: Network Analysis: Understand the basic principles and methods of network analysis and its applications in bioinformatics and genomics.

20: Pathway Analysis: Develop skills in the analysis and interpretation of biological pathways.

21: Data Visualization: Develop skills in the visualization and presentation of biological data.

22: Bioinformatics Databases.: Develop skills in the use of bioinformatics databases for the analysis of biological data.

23: Personalized Genomics: Understand the basic principles and methods of personalized genomics.

24: Current Topics in Bioinformatics and Genomics.: Understand current topics in bioinformatics and genomics research and their applications.

Tutorials:

1. Introduction to Bioinformatics and Genomics: This tutorial provides an overview of the field of bioinformatics and genomics, including the types of data analyzed, tools used, and applications in research.
2. Sequence Alignment: This tutorial covers the basics of sequence alignment, including types of alignment, algorithms, and tools commonly used.
3. Sequence Analysis: This tutorial covers the analysis of DNA and RNA sequences, including sequence annotation, motif discovery, and phylogenetic analysis.
4. Genome Assembly: This tutorial covers the process of genome assembly, including methods for assembling short reads into longer sequences.
5. Gene Prediction: This tutorial covers the process of gene prediction, including tools and algorithms used for identifying genes in genomic sequences.
6. Transcriptomics: This tutorial covers the analysis of transcriptomic data, including differential expression analysis, pathway analysis, and functional enrichment analysis.
7. Epigenomics: This tutorial covers the analysis of epigenomic data, including DNA methylation and histone modification data, and their role in gene regulation.
8. Structural Bioinformatics: This tutorial covers the analysis of protein structures, including methods for predicting protein structure, and analysis of protein-ligand interactions.
9. Comparative Genomics: This tutorial covers the comparison of genomes across different species, including methods for identifying conserved regions and evolutionary relationships.
10. Metagenomics: This tutorial covers the analysis of metagenomic data, including taxonomic and functional profiling of microbial communities.
11. Next-Generation Sequencing Technologies: This tutorial covers the principles of next-generation sequencing technologies, including Illumina, PacBio, and Oxford Nanopore sequencing.
12. Quality Control and Data Preprocessing: This tutorial covers the quality control and preprocessing of next-generation sequencing data, including trimming, filtering, and error correction.
13. Genome Annotation: This tutorial covers the annotation of genomic sequences, including the identification of genes, regulatory elements, and functional domains.
14. Variant Analysis: This tutorial covers the analysis of genetic variation, including single nucleotide polymorphisms (SNPs), insertions, and deletions.

15. Pathway Analysis: This tutorial covers the analysis of biological pathways, including identification of enriched pathways and analysis of pathway interactions.
16. Network Analysis: This tutorial covers the analysis of biological networks, including protein-protein interaction networks and gene co-expression networks.
17. Integrative Analysis: This tutorial covers the integration of multiple types of data, including genomics, transcriptomics, and epigenomics, to gain a comprehensive understanding of biological processes.

References:

1. Pevsner, J. (2015). Bioinformatics and functional genomics (3rd ed.). John Wiley & Sons.
2. Lesk, A. M. (2017). Introduction to bioinformatics (4th ed.). Oxford University Press.

2	Course title: Clinical Molecular Diagnostic Techniques	Course Code: MOLD-303

Overall Description and Aims:

The course aims to provide students with a comprehensive understanding of the principles and applications of molecular diagnostics in the diagnosis and management of diseases. The course will provide students with hands-on experience in laboratory techniques for the detection of genetic mutations, infectious agents, and other disease markers. By the end of the course, students will be able to demonstrate a detailed knowledge of the principles and applications of molecular diagnostics, as well as an ability to apply this knowledge in laboratory settings.

Intended Learning Outcomes of the Course:

Knowledge and Understanding:

1. Demonstrate a comprehensive understanding of the principles and applications of molecular diagnostics.
2. Understand the molecular basis of genetic mutations, infectious agents, and other disease markers.
3. Analyze and interpret molecular diagnostic data to inform the diagnosis and management of disease.

Intellectual Skills:

1. Critically evaluate the scientific literature on molecular diagnostics and its applications.
2. Apply theoretical knowledge to practical problem-solving scenarios.
3. Formulate and test hypotheses based on molecular diagnostic data.
4. Analyze and interpret complex molecular diagnostic datasets.

Professional and Practical Skills:

1. Perform molecular diagnostic techniques in a laboratory setting, including nucleic acid extraction, PCR, sequencing, and other techniques.
2. Analyze and interpret molecular diagnostic data to inform clinical decision making.
3. Communicate scientific concepts and research findings effectively in written and oral formats.

4. Work effectively in a laboratory environment, including following safety protocols and good laboratory practices.

General Transferable Skills:

1. Develop effective time-management and organizational skills.
2. Develop effective problem-solving and critical thinking abilities.
3. Develop team-working and collaboration skills.

Course Topics:

1. Introduction to Molecular Diagnostics.
    - Objective: To introduce students to the principles and applications of molecular diagnostics in the diagnosis and management of diseases.
2. Nucleic Acid Extraction.
    - Objective: To provide students with hands-on experience in the extraction of nucleic acids from biological samples.
3. PCR and qPCR.
    - Objective: To provide students with hands-on experience in the use of PCR and qPCR techniques for the detection of genetic mutations and other disease markers.
4. Sequencing.
    - Objective: To provide students with hands-on experience in DNA sequencing techniques for the detection of genetic mutations and other disease markers.
5. Microarrays.
    - Objective: To provide students with hands-on experience in the use of microarray techniques for the detection of genetic mutations and other disease markers.
6. Next-Generation Sequencing.
    - Objective: To provide students with an understanding of the principles and applications of next-generation sequencing techniques in molecular diagnostics.
7. Digital PCR .
    - Objective: To provide students with hands-on experience in the use of digital PCR techniques for the detection of genetic mutations and other disease markers.
8. CRISPR/Cas9.

- Objective: To provide students with an understanding of the principles and applications of CRISPR/Cas9 gene editing in molecular diagnostics.

9. Biomarkers.
    - Objective: To provide students with an understanding of the principles and applications of biomarkers in molecular diagnostics.
10. Gene Expression Profiling.
    - Objective: To provide students with hands-on experience in the use of gene expression profiling techniques in molecular diagnostics.
11. Epigenetics.
    - Objective: To provide students with an understanding of the principles and applications of epigenetics in molecular diagnostics.
12. Infectious Disease Diagnostics.
    - Objective: To provide students with hands-on experience in the use of molecular diagnostic techniques for the detection of infectious agents.
13. Cancer Diagnostics.
    - Objective: To provide students with an understanding of the principles and applications of molecular diagnostics in cancer diagnosis and management.
14. Cardiovascular Disease Diagnostics.
    - Objective: To provide students with an understanding of the molecular basis of cardiovascular diseases and the use of molecular diagnostic techniques in their diagnosis and management.
15. Neurological Disease Diagnostics.
    - Objective: To provide students with an understanding of the molecular basis of neurological diseases and the use of molecular diagnostic techniques in their diagnosis and management.
16. Respiratory Disease Diagnostics.
    - Objective: To provide students with an understanding of the molecular basis of respiratory diseases and the use of molecular diagnostic techniques in their diagnosis and management.
17. Renal Disease Diagnostics.

- Objective: To provide students with an understanding of the molecular basis of renal diseases and the use of molecular diagnostic techniques in their diagnosis and management.

18. Digestive Disease Diagnostics.
    - Objective: To provide students with an understanding of the molecular basis of digestive diseases and the use of molecular diagnostic techniques in their diagnosis and management.
19. Reproductive Health Diagnostics.
    - Objective: To provide students with an understanding of the molecular basis of reproductive health and the use of molecular diagnostic techniques in the diagnosis and management of reproductive disorders.
20. Inherited Genetic Disorder Diagnostics.
    - Objective: To provide students with an understanding of the molecular basis of inherited genetic disorders and the use of molecular diagnostic techniques in their diagnosis and management.
21. Emerging Technologies in Molecular Diagnostics.
    - Objective: To provide students with an understanding of emerging technologies in molecular diagnostics and their potential applications in disease diagnosis and management.

References:

1. Buckingham, L., & Flaws, M. L. (2017). Molecular Diagnostics: Fundamentals, Methods, and Clinical Applications. F.A. Davis Company.

2. Coleman, W. B., & Tsongalis, G. J. (2018). Clinical Molecular Diagnostics: The Essentials. Academic Press.

3	Course title: Histotechnology	Course Code: CYTO-305

Overall Description and Aims:

The course aims to introduce students to the fundamental principles and techniques used in the preparation, processing, and staining of biological tissues. The course aims to provide students with a strong foundation in the theoretical and practical aspects of histotechnology, as well as to develop their professional and transferable skills.

Intended Learning Outcomes: By the end of the course, students will be able to demonstrate the following:

Knowledge and Understanding:

1. The principles of microtechnique and the role of histology in biomedical sciences
2. The different types of fixatives and their effects on tissue structure and antigenicity
3. The various methods used for decalcification and other treatments for hard tissues
4. The steps involved in tissue processing and mounting
5. The types of dyes used in histotechnology and their staining mechanisms
6. The staining techniques used for tissues, blood, and other cell suspensions
7. The methods used for connective tissues, nucleic acids, organic functional groups, carbohydrates, lipids, pigments, and inorganic ions
8. The principles of enzyme histochemistry and the different classes of enzymes
9. The methods used for soluble organic compounds and metal reduction and precipitation
10. The principles of immunohistochemistry and the different types of antibodies

Intellectual Skills:

1. Analyze and interpret histological images and data
2. Apply critical thinking to solve problems in histotechnology
3. Evaluate the quality of tissue samples and staining protocols

Professional and Practical Skills:

1. Perform tissue processing, embedding, and sectioning
2. Prepare and use staining solutions for histological samples
3. Perform enzyme histochemistry and immunohistochemistry techniques

General Transferable Skills:

1. Work collaboratively in a team
2. Communicate scientific ideas effectively in written and oral formats
3. Develop effective time management and organizational skills

Course Topics:

1. Introduction to micro-technique

- Principles of histotechnology
- Types of histological techniques
- Ethical considerations in histology

2. Fixation

- Types of fixatives and their effects on tissue structure and antigenicity
- Factors affecting fixation
- Fixation protocols for different tissue types

3. Decalcification and other treatments for hard tissues

- Types of decalcifying agents and their effects on tissue structure
- Decalcification protocols for different tissue types
- Other treatments for hard tissues

4. Processing and mounting

- Tissue processing steps
- Types of embedding media
- Mounting techniques for histological sections

5. Dyes

- Types of dyes used in histotechnology
- Staining mechanisms of dyes
- Characteristics of good staining solutions

6. Staining with dyes in one or two colours

- Single and double staining techniques
- Staining protocols for different tissue types

- Troubleshooting staining problems

7. Staining blood and other cell suspensions

- Preparation of blood and other cell suspensions
- Staining techniques for blood and other cell suspensions
- Interpretation of stained blood smears

8. Methods for connective tissue

- Staining techniques for collagen and elastin fibers
- Other methods for connective tissue staining
- Troubleshooting connective tissue staining problems

9. Methods for nucleic acids

- Staining techniques for DNA and RNA
- Interpretation of nucleic acid stains
- Troubleshooting nucleic acid staining problems

10. Organic functional groups and protein histochemistry

- Staining techniques for organic functional groups
- Protein staining techniques
- Interpretation of protein stains

11. Carbohydrate histochemistry

- Staining techniques for carbohydrates
- Interpretation of carbohydrate stains
- Troubleshooting carbohydrate staining problems

12. Lipids

- Staining techniques for lipids
- Interpretation of lipid stains
- Troubleshooting lipid staining problems

13. Methods for pigments and inorganic ions

- Staining techniques for pigments and inorganic ions
- Interpretation of pigment and ion stains

- Troubleshooting pigment and ion staining problems

14. Enzyme histochemistry: general considerations

- Principles of enzyme histochemistry
- Types of enzymes and their substrates
- Factors affecting enzyme activity

15. Hydrolytic enzymes

- Staining techniques for hydrolases
- Interpretation of hydrolase stains
- Troubleshooting hydrolase staining problems

16. Oxidoreductases

- Staining techniques for oxidoreductases
- Interpretation of oxidoreductase stains
- Troubleshooting oxidoreductase staining problems

17. Methods for soluble organic compounds of low molecular weight

- Staining techniques for small molecules
- Interpretation of small molecule stains
- Troubleshooting small molecule staining problems

18. Metal reduction and precipitation methods

- Staining techniques for metals
- Interpretation of metal stains
- Troubleshooting metal staining problems

19. Immunohistochemistry

- Principles of immunohistochemistry
- Types of antibodies and their uses
- Troubleshooting immunohistochemistry problems

20. Special techniques

- Special techniques and staining protocols
- New developments in histotechnology

- Future directions in histotechnology research

Practical Class:

1. Introduction to micro-technique:

- To introduce students to the basic principles of histotechnology.
- Practical: Preparation and examination of plant and animal tissues using light microscopy.

2. Fixation:

- To familiarize students with the different types of fixatives and their effects on tissue structure and antigenicity.
- Practical: Fixation of different tissue types using different fixatives, and examination of the effects of fixation on tissue structure.

3. Decalcification and other treatments for hard tissues:

- To teach students the different methods used for decalcification and other treatments for hard tissues.
- Practical: Decalcification of bone tissue using different decalcifying agents and examination of the effects of decalcification on tissue structure.

4. Processing and mounting:

- To teach students the steps involved in tissue processing and mounting.
- Practical: Processing and embedding of different tissue types, sectioning and mounting of histological sections.

5. Dyes:

- To teach students the different types of dyes used in histotechnology and their staining mechanisms.
- Practical: Preparation and use of different staining solutions for histological samples, and examination of the effects of different dyes on tissue structure.

6. Staining with dyes in one or two colours:

- To teach students the different staining techniques used in histotechnology.

- Practical: Single and double staining of different tissue types using different staining protocols.

7. Staining blood and other cell suspensions:

- To teach students the preparation and staining of blood and other cell suspensions.
- Practical: Preparation of blood and other cell suspensions, staining of blood smears and examination of stained cells.

8. Methods for connective tissue:

- To teach students the different methods used for connective tissue staining.
- Practical: Staining of collagen and elastin fibers using different staining protocols, and examination of the effects of staining on tissue structure.

9. Methods for nucleic acids:

- To teach students the different methods used for nucleic acid staining.
- Practical: Staining of DNA and RNA using different staining protocols, and examination of the effects of staining on tissue structure.

10. Organic functional groups and protein histochemistry:

- To teach students the different methods used for organic functional group and protein staining.
- Practical: Staining of different organic functional groups and proteins using different staining protocols, and examination of the effects of staining on tissue structure.

11. Carbohydrate histochemistry:

- To teach students the different methods used for carbohydrate staining.
- Practical: Staining of different carbohydrates using different staining protocols, and examination of the effects of staining on tissue structure.

12. Lipids:

- To teach students the different methods used for lipid staining.
- Practical: Staining of different lipids using different staining protocols, and examination of the effects of staining on tissue structure.

13. Methods for pigments and inorganic ions:

- To teach students the different methods used for pigment and inorganic ion staining.
- Practical: Staining of different pigments and inorganic ions using different staining protocols, and examination of the effects of staining on tissue structure.

14. Enzyme histochemistry: general considerations:

- To teach students the different methods used for enzyme staining.
- Practical: Staining of different enzymes using different staining protocols, and examination of the effects of staining on tissue structure.

15. Hydrolytic enzymes:

- To teach students the different methods used for hydrolytic enzyme staining.
- Practical: Staining of different hydrolytic enzymes using different staining protocols, and examination of the effects of staining on tissue structure.

16. Oxidoreductases:

- : To teach students the different methods used for oxidoreductase staining.
- Practical: Staining of different oxidoreductases using different staining protocols, and examination of the effects of staining on tissue structure.

17. Methods for soluble organic compounds of low molecular weight:

- To teach students the different methods used for staining small organic compounds.
- Practical: Staining of different small organic compounds using different staining protocols, and examination of the effects of staining on tissue structure.

18. Metal reduction and precipitation methods:

- To teach students the different methods used for metal staining.
- Practical: Staining of different metals using different staining protocols, and examination of the effects of staining on tissue structure.

19.Immunohistochemistry:

- To teach students the different methods used for immunohistochemistry staining.
- Practical: Staining of different antigens using different immunohistochemistry protocols, and examination of the effects of staining on tissue structure.

References:

1. Bancroft, J.D. and Gamble, M. Theory and Practice of Histological Techniques. 6th edition. Churchill Livingstone, Elsevier, 2008.
2. Kiernan, J.A. Histological and Histochemical Methods: Theory and Practice. 5th edition. Scion Publishing Ltd, 2015.

4	Course title: Medical Genetics	Course Code: MOLD-304

Overall description and Aims:

The course is designed to provide students with an in-depth understanding of the principles and applications of genetics in medicine, with a focus on molecular, cytogenetic, immunogenetic, population, and mathematical genetics. The course aims to provide students with an understanding of the history and impact of genetics in medicine, DNA technology and its applications, methods of chromosome analysis, immune genetics, and genetic disorders. Furthermore, the course will provide students with knowledge about the ethical, legal, and social issues in genetics, genetic counseling, and genetic testing, as well as the application of genetics in society.

Intended Learning Outcomes:
Upon completion of the Medical Genetics undergraduate course, students should have achieved the following learning outcomes:

Knowledge and Understanding:

- An understanding of the history and impact of genetics in medicine.
- Knowledge of DNA as the basis of inheritance and the structure and function of genes.
- Understanding of the types of genetic disorders, chromosome abnormalities, and patterns of inheritance.
- An understanding of DNA technology and its applications, including techniques of DNA analysis, DNA sequencing, and the application of DNA sequence polymorphisms.
- Knowledge of immune genetics, including innate and specific acquired immunity, blood groups, HLA, and immunology of transplantation.
- Knowledge of population and mathematical genetics, including the Hardy-Weinberg principle, factors that alter gene frequency, consanguinity, segregation analysis, genetic linkage, and risk calculation.
- Understanding of genetic disorders, including hemoglobinopathies, disorders of coagulation and bleeding, and biochemical genetics.

Intellectual Skills:

- The ability to critically evaluate scientific literature related to genetics in medicine.
- The ability to analyze data obtained from DNA sequencing and DNA analysis techniques.

- The ability to perform segregation analysis and calculate risks of inheritance.

Professional and Practical Skills:

- The ability to conduct genetic counseling and genetic testing, including preimplantation genetic diagnosis, prenatal diagnosis and screening, carrier testing, fetal DNA analysis, and preconception counseling.
- The ability to conduct newborn screening and pharmacogenetic testing.
- The ability to understand the ethical, legal, and social issues in genetics and apply this knowledge in clinical practice.

General Transferable Skills:

- The ability to communicate effectively about genetics in medicine with healthcare professionals, patients, and the general public.
- The ability to work effectively in a team and collaborate with other healthcare professionals.
- The ability to adapt to new technologies and techniques in the field of genetics.

Course topics:

A. Principles of Human Genetics (review)

The History and Impact of Genetics in Medicine
- Gregor Mendel and the Laws of Inheritance
- DNA as the Basis of Inheritance
- Types of Genetic Disorders

Basic Cell Biology: Structure and Function of genes
- DNA, RNA, and Protein:
- DNA replication, Transcription, Translation
- Mutations and Mutagenesis

Chromosomes and Cell Division
- Human Chromosomes
- Cell Division- Mitosis, Meiosis, Gametogenesis
- Chromosome Abnormalities

Patterns of Inheritance
- Family Studies
- Mendelian Inheritance

- Multiple Alleles and Complex Traits
- Polygenic and Multifactorial Inheritance

B. Molecular Genetics

DNA Technology and Applications
- DNA Cloning and The PCR
- Techniques of DNA Analysis
- DNA Sequencing
- Application of DNA sequence polymorphisms

Mapping and Identifying Genes for Monogenic Disorders
- Positional Cloning
- The Human Genome Project and its Applications

C. Cytogenetics
- Methods of chromosome analysis
- Fluorescent In-Situ Hybridization
- Comparative Genomic Hybridization
- Prenatal cytogenetics
- Cancer cytogenetics

D. Immunogenetics
- Innate Immunity
- Specific Acquired Immunity
- Blood Groups
- HLA and Immunology of transplantation

E. Population And Mathematical Genetics
- Hardy-Weinberg Principle and its Applications
- Factors that alter gene frequency
- Consanguinity and its consequences
- Segregation Analysis
- Genetic Linkage
- Risk Calculation

F. Genetics In Medicine
1 Hemoglobin and the Hemoglobinopathies
- Disorders of Hemoglobin

- Clinical Variation of the Hemoglobinopathies
- Antenatal and Newborn Hemoglobinopathy Screening

2 Disorders of coagulation and bleeding
- Factor VIII
- Factor IX
- Other disorders of coagulation

3 Biochemical Genetics
- Introduction of Inborn Errors of Metabolism
- Disorders of Amino Acid and Branched-Chain Amino Acid Metabolism
- Urea Cycle Disorders
- Disorders of Carbohydrate Metabolism
- Disorders of Lipid Metabolism
- Lysosomal Storage Disorders
- Disorders of Purine/Pyrimidine Metabolism

G. Genetics In Society
- Ethical, Legal and Social Issues (ELSI) in Genetics
- Genetic Counseling and Genetic Testing
- Reproductive Genetics- Preimplantation Genetic Diagnosis (PGD), Prenatal

Diagnosis and Screening, Carrier testing, Fetal DNA analysis, Preconception counseling
- Predictive Testing and Presymptomatic Testing
- Newborn Screening
- Pharmacogenetics
- Forensic Genetics

Laboratory Classes:

1. Molecular techniques:

    - Isolation and quantification of DNA
    - Designing probes and primers
    - Standard and modified PCR techniques
    - Real-time PCR
    - MLPA analysis
    - Isotopic and non-isotopic Southern blotting

- Western blotting
- DNA sequencing, including massively parallel sequencing
- Microarray analysis
- Bioinformatics analysis as applied to sequencing and microarrays
- Genetic Counseling
- Role-playing exercises: Divide participants into pairs or small groups and assign them different roles to play, such as a genetic counselor and a patient, or a genetic counselor and a physician. Provide them with a scenario and a list of questions or concerns that the patient or physician might have. Encourage them to practice active listening, empathy, and clear communication skills.
- Case studies: Provide participants with case studies that illustrate different genetic counseling scenarios, such as carrier testing, prenatal diagnosis, or cancer risk assessment. Ask them to analyze the case, identify the relevant genetic and medical information, consider the ethical and psychosocial implications, and formulate a counseling plan. Discuss the case as a group and compare different approaches and perspectives.
- Family pedigrees: Provide participants with a family pedigree that shows a genetic condition or risk factor. Ask them to interpret the pedigree, identify the mode of inheritance, calculate the risk of recurrence, and discuss the options for testing, management, and counseling. Encourage them to use visual aids, such as colored pencils or software programs, to enhance their analysis and presentation.

References:

Emery's Elements of Medical Genetics, 16th edition. Edited by Peter Turnpenny, Sian Ellard, and Ruth Lovering. Elsevier; 2019.

Medical Genetics at a Glance, 4th edition. Edited by Dorian J. Pritchard and Bruce R. Korf. Wiley-Blackwell; 2020.

5	Course title: Molecular Basis of Disease	Course Code: MOLD-305

The overall aim of the course is to provide students with an in-depth understanding of the molecular mechanisms that underlie human disease. This course will introduce students to a wide range of molecular and cellular processes that contribute to the development and progression of disease. By the end of the course, students should be able to analyze and interpret the molecular mechanisms underlying a wide range of diseases.

Intended Learning Outcomes of the Course:

The following are the intended learning outcomes of the course:

Knowledge and Understanding:

1. Demonstrate a detailed understanding of the molecular basis of human disease.
2. Explain the key molecular and cellular processes that contribute to the development and progression of disease.
3. Understand the genetic and environmental factors that contribute to disease susceptibility.
4. Analyze the molecular mechanisms underlying the pathogenesis of a range of human diseases.

Intellectual Skills:

1. Critically evaluate the scientific literature on the molecular basis of disease.
2. Apply theoretical knowledge to practical problem-solving scenarios.
3. Formulate and test hypotheses based on molecular data.
4. Synthesis of information from multiple sources to identify the molecular mechanisms of a specific disease.
5. Analyze and interpret complex datasets from a range of molecular techniques.

Professional and Practical Skills:

1. Communicate scientific concepts and research findings effectively in written and oral formats.
2. Work effectively in a laboratory environment, including handling of biological materials and molecular techniques.

3. Understanding of laboratory techniques commonly used in molecular biology and disease research.

General Transferable Skills:

1. Independent learning and time management.
2.
3. Demonstrate effective time-management and organizational skills.
4. Develop effective problem-solving and critical thinking abilities.
5. Develop written and oral communication skills.
6. Develop team-working and collaboration skills.

Course Topics:

1. Introduction to Molecular Basis of Disease.
    - Objective: To introduce students to the molecular mechanisms that underlie human disease, including genetic and environmental factors.
2. DNA Replication, Repair and Mutations.
    - Objective: To understand the molecular basis of DNA replication and repair, as well as the causes and consequences of mutations.
3. Cell Cycle and Cancer.
    - Objective: To understand the molecular basis of the cell cycle and the molecular mechanisms underlying the development and progression of cancer.
4. Apoptosis and Cell Death.
    - Objective: To understand the molecular mechanisms of apoptosis and other forms of cell death, and their roles in disease.
5. Protein Folding and Misfolding.
    - Objective: To understand the molecular mechanisms of protein folding and misfolding, and their roles in disease.
6. Prion Diseases.
    - Objective: To understand the molecular mechanisms of prion diseases and their transmission.
7. Protein Trafficking and Secretion.
    - Objective: To understand the molecular mechanisms of protein trafficking and secretion, and their roles in disease.
8. Metabolism and Disease.

- Objective: To understand the molecular mechanisms of metabolism and their roles in disease, including metabolic disorders.
- Diabetes
    1. Diabetes,
    2. Lipoproteins and Lipid Dysregulation
    3. Insulin Resistance

9. Immune Response and Inflammation.
    - Objective: To understand the molecular mechanisms of the immune response and inflammation, including:
    - Autoimmune diseases:
    - Immune Dysregulation
    - Viral Infection and Immunopathology
        1. Viral infection: Hepatitis C Virus
    - Chronic Liver Disease and Clinical Consequences
    - Disturbances in Immunity
    - intestinal Immune Responses
        1. inflammatory Bowel Diseases (IBD)
10. Systemic Inflammation and Cancer
    - Cancer Cachexia
    - inflammation and Cancer
    - Cancer Cachexia - Inflammation and Muscle Effects
    - Muscle Wasting in Cancer Cachexia
    - Inflammation and Pancreatic Cancer
    - Hepatitis and Hepatocellular Carcinoma
11. Infectious Diseases.
    - Objective: To understand the molecular mechanisms of infectious diseases, including viral and bacterial infections, and the host response to infection.
12. Neurodegenerative.

    - Diseases Objective: To understand the molecular mechanisms of neurodegenerative diseases, including Alzheimer's, Parkinson's and Huntington's diseases.

16. Cardiovascular Diseases.
    - Objective: To understand the molecular mechanisms of cardiovascular diseases, including:
    - Systemic Inflammation
        1. Coronary Artery Disease

2. Atherosclerosis

- hypertension
- heart failure:
- Cardiovascular Disease
- Inflammation and Cardiovascular Dysfunction
- Heart Diseases and Congenital Heart Defects

17. Respiratory Diseases.
    - Objective: To understand the molecular mechanisms of respiratory diseases, including asthma and chronic obstructive pulmonary disease (COPD).
    - Allergy and Hypersensitivity
        1. Molecular basis of Allergy
        2. Molecular basis of Asthma
18. Digestive Diseases .
    - Objective: To understand the molecular mechanisms of digestive diseases, including inflammatory bowel disease and liver disease.
19. Endocrine Diseases.
    - Objective: To understand the molecular mechanisms of endocrine diseases, including diabetes and thyroid disorders.
20. Renal Diseases.
    - Objective: To understand the molecular mechanisms of renal diseases, including kidney disease and renal failure.
21. Musculoskeletal Diseases.
    - Objective: To understand the molecular mechanisms of musculoskeletal diseases, including osteoarthritis and rheumatoid arthritis.
22. Reproductive Health and Disease.
    - Objective: To understand the molecular mechanisms of reproductive health and disease, including infertility and reproductive cancers.
23. Genetic Diseases.
    - Objective: To understand the molecular mechanisms of genetic diseases, including inherited disorders and chromosomal abnormalities
    - Cystic Fibrosis
    - Ataxia Telangiectasia and Related Diseases

Laboratory classes:

- Cell Culture and Cell Proliferation Assays
- Cell Cycle Analysis by Flow Cytometry
- Cancer Cell Invasion and Metastasis Assays
- Apoptosis Assays
- Necrosis and Autophagy Assays
- Caspase Activation and Inhibition Assays
- Protein Expression and Purification
- Protein Folding and Misfolding Assays
- Protein Aggregation and Clearance Assays
- Prion Protein Expression and Purification
- Protein Trafficking Assays
- Endoplasmic Reticulum Stress and Unfolded Protein Response Assays
- Glucose and Lipid Metabolism Assays
- Mitochondrial Dysfunction assay
- Immune Cell Isolation and Activation Assays
- Inflammatory Cytokine and Chemokine Assays
- Cancer Cell Immune Evasion Assays
- Cancer Cachexia and Muscle Wasting Assays
- Viral and Bacterial Pathogen Detection and Identification
- Host-Pathogen Interaction Assays
- Neurotransmitter Release and Reuptake Assays
- Protein Aggregation and Neuroinflammation Assays
- Neurodegeneration and Neuroprotection Assays
- Vascular Cell Biology and Atherosclerosis Assays
- Cardiac Function and Remodeling Assays
- Lung Function and Airway Resistance Assays
- Inflammatory Signaling and Asthma Assays
- COPD and Lung Fibrosis Assays
- Gut Microbiome Analysis and Dysbiosis Assays
- Liver Function and Disease Assays

References:

1. Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K., & Walter, P. (2015). Molecular biology of the cell (6th ed.). Garland Science.
2. Kumar, V., Abbas, A. K., & Aster, J. C. (2017). Robbins and Cotran pathologic basis of disease (10th ed.). Elsevier.

6	Course title: Molecular Immunology	Course Code: MOLD-307

Overall Description:

This course provides students with an in-depth understanding of the molecular and cellular basis of the immune system. The course covers a wide range of topics related to immunology, including immune cell development, antigen recognition, signaling pathways, and immune responses to pathogens and tumors. The course also includes practical classes that provide students with hands-on experience in a variety of immunology techniques.

Intended Learning Outcomes:

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

Knowledge and Understanding:

1. Knowledge of the molecular and cellular basis of the immune system.
2. Understanding of the mechanisms of immune cell development, antigen recognition, and signaling pathways.
3. Understanding of the immune responses to pathogens and tumors.
4. Understanding of the principles of immunotherapy and vaccine development.

Intellectual Skills:

- Critically evaluate scientific literature in the field of immunology.
- Analyze and interpret experimental data in the context of immunology.
- Formulate hypotheses and design experiments to test them.
- Professional and Practical Skills:
- Demonstrate proficiency in laboratory techniques used in the field of immunology.
- Communicate scientific ideas and data effectively in both oral and written formats.
- Work collaboratively as part of a team to design and conduct experiments.

Professional and Practical Skills:

1. Ability to perform a range of immunology techniques.
2. Ability to work effectively in a laboratory environment.
3. Ability to write laboratory reports and scientific papers.

General Transferable Skills:

- Develop critical thinking and problem-solving skills.
- Develop time-management and organization skills.
- Develop written and oral communication skills.

Course Topics:

1. Properties and Overview of Immune Responses
- Innate and Adaptive Immunity
- Innate Immunity
- Adaptive Immunity

2. Cells and Tissues of the Immune System
- Cells of the Immune System
- Anatomy and Functions of Lymphoid Tissues

3. Leukocyte Circulation and Migration Into Tissues
- Overview of Leukocyte Migration
- Adhesion Molecules on Leukocytes and Endothelial Cells Involved in Leukocyte Recruitment
- Chemokines and Chemokine Receptors
- Leukocyte-Endothelial Interactions and Leukocyte Recruitment into Tissues
- Migration of Neutrophils and Monocytes to Sites of Infection or Tissue Injury
- Migration and Recirculation of T Lymphocytes
- Migration of B Lymphocytes

4. Innate Immunity
- Overview of Innate Immunity
- Recognition of Microbes and Damaged Tissue by the Innate Immune System
- Cellular Pattern Recognition Receptors
- Cellular Components of the Innate Immune System
- Soluble Effector Molecules of Innate Immunity
- The Inflammatory Response
- The Antiviral Response
- Stimulation of Adaptive Immunity
- Mechanisms that Limit Innate Immune Responses

5. Antibodies and Antigens
- Antibody Structure
- Synthesis, Assembly, and Expression of Immunoglobulin Molecules
- Antibody Binding of Antigens

- Structure-Function Relationships in Antibody Molecules

6. Antigen Presentation to T Lymphocytes and the Function of Major Histocompatibility

- Properties of Antigens Recognized by T Lymphocytes
- Antigen Capture and the Functions of Antigen-Presenting Cells
- The Major Histocompatibility Complex
- Processing of Protein Antigens
- Presentation of Nonprotein Antigens to T Cells

7. Immune Receptors and Signal Transduction

- Overview of Signal Transduction
- The Immune Receptor Family
- The T Cell Receptor Complex and T Cell Signaling
- The B Lymphocyte Antigen Receptor Complex
- The Attenuation of Immune Receptor Signaling
- Cytokine Receptors and Signaling

8. Lymphocyte Development and Antigen Receptor Gene Rearrangement

- Overview of Lymphocyte Development
- Rearrangement of Antigen Receptor Genes in B and T Lymphocytes
- B Lymphocyte Development
- T Lymphocyte Development

9. Activation of T Lymphocytes

- Overview of T Lymphocyte Activation
- Signals for T Lymphocyte Activation
- Functional Responses of T Lymphocytes
- Decline of T Cell Responses

10. Differentiation and Functions of CD4+ Effector T Cells

- Overview of CD4+ T Cell–Mediated Immune Responses
- Subsets of CD4+ Effector T Cells
- The Th1 Subset
- The Th2 Subset
- The Th17 Subset
- Functions of Other HELPER T Cell Subsets

11. Differentiation and Functions of CD8+ Effector T Cells

- Differentiation of CD8+ T Cells Into Cytotoxic T Lymphocytes
- Effector Functions of CD8+ Cytotoxic T Lymphocytes
- Cytokine Production by CD8+ Effector T Cells
- Roles of CD8+ Cytotoxic T Lymphocytes in Host Defense

12. B Cell Activation and Antibody Production

- Overview of Humoral Immune Responses
- Antigen Recognition and Antigen-Induced B Cell Activation
- Helper T Cell–Dependent Antibody Responses to Protein Antigens
- Antibody Responses to T-Independent Antigens
- Antibody Feedback: Regulation of Humoral Immune Responses By Fc Receptors

13. Effector Mechanisms of Humoral Immunity

- Overview of Humoral Immunity
- Neutralization of Microbes and Microbial Toxins
- Antibody-Mediated Opsonization and Phagocytosis
- The Complement System

14. Specialized Immunity at Epithelial Barriers and in Immune Privileged Tissues

- General Features of Immunity at Epithelial Barriers
- Immunity in the Gastrointestinal System
- Immunity in Other Mucosal Tissues
- The Cutaneous Immune System
- Immune-Privileged Tissues
- Immunity in the Mammalian Fetus and Newborn

15. Immunologic Tolerance and Autoimmunity

- Overview of Immunologic Tolerance
- T Lymphocyte Tolerance
- B Lymphocyte Tolerance
- Tolerance to Commensal Microbes and Other Foreign Antigens
- Mechanisms of Autoimmunity

16. Immunity to Microbes

- Overview of Immune Responses to Microbes
- Immunity to Extracellular Bacteria
- Immunity to Intracellular Bacteria
- Immunity to Fungi
- Immunity to Viruses
- Immunity to Parasites
- Strategies for Vaccine Development

17. Transplantation Immunology

- General Principles of Transplantation Immunology
- Immune Responses to Allografts
- Patterns and Mechanisms of Allograft Rejection
- Prevention and Treatment of Allograft Rejection
- Xenogeneic Transplantation
- Blood Transfusion and the Abo and Rh Blood Group Antigens

- Hematopoietic Stem Cell (HSC) Transplantation

18. Tumor Immunology

- Overview of Tumor Immunity
- Tumor Antigens
- Immune Responses To Tumors
- Evasion of Immune Responses by Tumors
- Immunotherapy For Tumors

19. Hypersensitivity Disorders

- Causes of Hypersensitivity Diseases
- Mechanisms and Classification of Hypersensitivity Reactions
- Diseases Caused by Antibodies and Antigen-Antibody Complexes
- Diseases Caused by T Lymphocytes
- Therapeutic Approaches for Immunologic Diseases
- Selected Immunologic Diseases: Pathogenesis and Therapeutic Strategies

20. Allergy

- Overview of IgE-Dependent Allergic Reactions
- Production of IgE
- Cells Involved in Allergic Reactions
- Reactions Dependent on IgE and Mast Cells
- Genetic Susceptibility to Allergic Disease
- Allergic Diseases in Humans: Pathogenesis and Therapy
- The Protective Roles of Immune Reactions Mediated by IgE and Mast Cells

21. Primary and Acquired Immunodeficiencies

- Overview of Immunodeficiency Diseases
- Primary (Congenital) Immunodeficiencies
- Secondary (Acquired) Immunodeficiencies
- Human Immunodeficiency Virus and Acquired Immunodeficiency Syndrome

For each topic, students will be able to:

1. Define and explain key terms and concepts.
2. Describe the relevant cellular and molecular mechanisms.
3. Analyze and interpret experimental data in the context of the topic.
4. Discuss the relevance of the topic to human health and disease.

Practical Classes and Objectives:

1. Flow Cytometry: Students will learn how to perform flow cytometry and analyze the resulting data.

2. ELISA: Students will learn how to perform ELISA and analyze the resulting data.
3. Western Blotting: Students will learn how to perform western blotting and analyze the resulting data.
4. PCR: Students will learn how to perform PCR and analyze the resulting data.
5. Cloning: Students will learn how to perform cloning and analyze the resulting data.
6. Gene Expression Analysis: Students will learn how to perform gene expression analysis and analyze the resulting data.
7. Bioinformatics Tools: Students will learn how to use bioinformatics tools for sequence alignment, database searching, and data analysis.
8. Antibody Production: Students will learn how to produce and purify monoclonal antibodies.
9. Cell Culture: Students will learn how to culture and manipulate immune cells in vitro.
10. Animal Models of Immune Disease: Students will learn how to use animal models to study immune disease.
11. Immune Assays: Students will learn how to perform a variety of immune assays, including cytokine assays and cytotoxicity assays.
12. Immune Cell Isolation: Students will learn how to isolate different immune cell populations from blood and tissues.
13. Microscopy: Students will learn how to use microscopy to visualize immune cells and tissues.
14. Immunohistochemistry: Students will learn how to perform immunohistochemistry and analyze the resulting data.
15. Vaccine Design and Testing: Students will learn how to design and test vaccines using animal models and human samples.

References:

1. Janeway, C. A., Travers, P., Walport, M., & Shlomchik, M. J. (2001). Immunobiology: the immune system in health and disease. Garland Science.
2. Murphy, K., & Weaver, C. (2016). Janeway's immunobiology. Garland Science.

7	Course title: Molecular Oncology	Course Code: MOLD-308

Overall Description:

The course focuses on the study of cancer at the molecular level. The course is designed to provide students with a comprehensive understanding of the molecular mechanisms that underlie the development and progression of cancer. The course will cover a broad range of topics, including genetics, epigenetics, signal transduction, genomics, proteomics, and metabolomics. In addition, the course will cover the use of various molecular techniques for cancer diagnosis, treatment, and prevention. The course will include lectures, laboratory sessions, and independent study.

Intended Learning Outcomes:

By the end of the course, students will be expected to have achieved the following learning outcomes:

Knowledge and Understanding:

1. Understand the key concepts and terminology related to cancer biology and molecular oncology
2. Describe the molecular mechanisms underlying oncogenesis, including genetic and epigenetic alterations
3. Explain the molecular pathways involved in tumor progression and metastasis
4. Analyze the latest advances in cancer research and emerging trends in the field
5. Evaluate the potential impact of molecular oncology research on clinical practice and public health
6. Demonstrate a comprehensive understanding of the molecular mechanisms that underlie the development and progression of cancer.
7. Understand the role of genetics, epigenetics, signal transduction, genomics, proteomics, and metabolomics in cancer biology.
8. Understand the principles and techniques used in cancer diagnosis, treatment, and prevention.

Intellectual Skills:

1. Critically evaluate scientific literature related to cancer biology.
2. Design and carry out experiments to investigate the molecular mechanisms of cancer.
3. Analyze and interpret complex data sets related to cancer biology.

4. Apply critical thinking and problem-solving skills to analyze complex biological problems

Professional and Practical Skills:

1. Demonstrate proficiency in laboratory techniques used in molecular oncology research
2. Develop effective communication skills to convey scientific concepts to both scientific and non-scientific audiences
3. Develop an understanding of the ethical issues related to cancer research and its application to clinical practice

General Transferable Skills:

1. Demonstrate effective time-management and organization skills
2. Develop effective teamwork and collaboration skills
3. Apply knowledge and understanding of molecular oncology to real-world scenarios

Course Topics:

1. Introduction to Cancer Biology: Understand the definition of cancer and its historical context, the hallmarks of cancer, and the basic principles of cancer development.
2. Oncogenes and Tumor Suppressor Genes: Understand the role of oncogenes and tumor suppressor genes in cancer development and progression, and the mechanisms by which they are regulated.
3. Genetic and Epigenetic Alterations in Cancer: Understand the role of genetic and epigenetic alterations in cancer development and progression, and their potential as therapeutic targets.
4. DNA Damage and Repair: Analyze the mechanisms of DNA damage and repair, and their impact on cancer development and treatment.
5. Cell Signaling Pathways in Cancer: Understand the molecular pathways involved in tumor progression and metastasis, including cell cycle regulation, apoptosis, and angiogenesis.
6. Tumor Microenvironment: Analyze the components of the tumor microenvironment and their impact on cancer development and progression, including immune cells, stromal cells, and extracellular matrix.
7. Cancer Immunology and Immunotherapy: Understand the role of the immune system in cancer and the potential of immunotherapy for cancer treatment.

8. Molecular Diagnostics and Imaging in Cancer: Understand the latest diagnostic and imaging techniques used in cancer diagnosis and monitoring, including molecular profiling and PET imaging.
9. Cancer Therapeutics: Understand the different types of cancer treatments and their molecular targets, including chemotherapy, targeted therapy, and radiation therapy.
10. Precision Medicine: Analyze the potential of precision medicine in cancer treatment, including the use of genomic and proteomic information to guide treatment decisions.
11. Cancer Stem Cells: Understand the role of cancer stem cells in tumor development and treatment, and their potential as therapeutic targets.
12. Cancer Genomics: Analyze the impact of genomics on cancer research and treatment, including the use of next-generation sequencing and bioinformatics.
13. Translational Cancer Research: Understand the process of translating basic cancer research into clinical practice, including the stages of drug development and clinical trials.
14. Cancer Epidemiology: Describe the incidence and prevalence of cancer and the risk factors associated with cancer development, including lifestyle factors and genetic predisposition.
15. Cancer Prevention: Analyze the potential of cancer prevention strategies, including lifestyle changes and early detection, and their impact on public health.
16. Emerging Trends in Cancer Research: Analyze the latest advances in cancer research and emerging trends in the field, including immunometabolism, single-cell sequencing, and synthetic biology.

Practical Classes:

1. DNA Isolation and Analysis: Develop proficiency in DNA isolation and analysis techniques, including gel electrophoresis and PCR.
2. Cell Culture and Transformation Assays: Develop proficiency in cell culture techniques and transformation assays, including soft agar and Matrigel assays.
3. Western Blotting and Immunohistochemistry: Develop proficiency in Western blotting and immunohistochemistry techniques, including antigen retrieval and signal detection.
4. Microarray and Next-Generation Sequencing: Develop proficiency in microarray and next-generation sequencing techniques, including data analysis and interpretation.

5. Flow Cytometry and Cell Sorting: Develop proficiency in flow cytometry and cell sorting techniques, including gating and data analysis.
6. Transfection and Gene Expression Analysis: Develop proficiency in transfection and gene expression analysis techniques, including luciferase assays and qPCR.
7. Animal Models of Cancer: Develop proficiency in the use of animal models of cancer, including tumor implantation and drug administration.
8. In vitro Drug Screening: Develop proficiency in in vitro drug screening techniques, including dose-response assays and drug combination studies.
9. Radiation Therapy: Develop proficiency in the use of radiation therapy for cancer treatment, including dosimetry and treatment planning.
10. Chemotherapy: Develop proficiency in the use of chemotherapy for cancer treatment, including drug delivery and toxicity assessment.
11. Targeted Therapy: Develop proficiency in the use of targeted therapy for cancer treatment, including the identification of molecular targets and the design of small molecules and biologics.
12. Immunotherapy: Develop proficiency in the use of immunotherapy for cancer treatment, including the design of monoclonal antibodies and T cell therapies.
13. Clinical Trials: Develop proficiency in the design and implementation of clinical trials for cancer treatment, including the selection of endpoints and the monitoring of adverse events.
14. Molecular Imaging: Develop proficiency in molecular imaging techniques for cancer diagnosis and monitoring, including PET and MRI.
15. Bioinformatics: Develop proficiency in bioinformatics tools and databases for cancer research, including gene expression analysis and pathway analysis.
16. Cancer Epidemiology: Develop proficiency in the analysis of cancer epidemiological data, including incidence and mortality rates and risk factor analysis.
17. Cancer Prevention: Develop proficiency in the design and implementation of cancer prevention strategies, including lifestyle interventions and screening programs.
18. Ethics in Cancer Research: Develop proficiency in the analysis of ethical issues related to cancer research and its application to clinical practice, including informed consent and privacy.
19. Commercialization and Intellectual Property in Cancer Research: Develop proficiency in the analysis of commercialization and intellectual property issues related to cancer research, including patent law and licensing agreements.

References:

1. Weinberg, R. A. (2013). The biology of cancer. Garland Science.
2. Hanahan, D., & Weinberg, R. A. (2011). Hallmarks of cancer: the next generation. Cell, 144(5), 646-674.
3. Abbas, A. K., Lichtman, A. H., & Pillai, S. (2021). Cellular and Molecular Immunology (10th ed.). Elsevier.

8	Course title: Research Methodology and Data Analysis	Course Code: BMSC-301

Overall Description and Aims:

The course intends to provide students with an extensive comprehension of research methodologies and data analysis techniques applicable to various disciplines. Its goal is to equip students with the skills required to develop research proposals, conduct research, gather data, perform data analysis, and interpret results. Additionally, the course emphasizes improving students' critical thinking and problem-solving abilities. Specifically, the course aims to impart knowledge about research methodologies and data analysis techniques applicable to medical research, thereby enabling students to develop research proposals, conduct research, collect data, analyze data, and interpret results in the medical field.

Knowledge and Understanding:

- Understand the basic principles of research methodology in biomedical fields, including study design, sampling, data collection, and analysis
- Develop knowledge and understanding of the concepts and theories related to research methodology and data analysis in biomedical sciences
- Demonstrate intellectual skills in analyzing and evaluating research literature, formulating research questions and hypotheses, and selecting appropriate research methodologies
- Develop professional and practical skills in designing and conducting research projects, collecting and analyzing data, and presenting research findings
- Understand the principles of scientific writing and research communication in biomedical fields

Intellectual Skills:

- Develop critical thinking and problem-solving skills through analyzing and interpreting research data
- Develop the ability to formulate research questions, hypotheses, and objectives
- Develop the ability to design and implement research studies in biomedical fields
- Develop the ability to evaluate the strengths and limitations of different research methodologies in biomedical fields

Professional and Practical Skills:

- Develop the skills to effectively communicate research findings to a range of audiences
- Develop the skills to write scientific research proposals and manuscripts in biomedical fields
- Develop the skills to analyze and interpret research data using statistical software and other tools
- Develop the skills to manage and organize research data in biomedical fields

General Transferable Skills:

- Develop general transferable skills in critical thinking, problem-solving, communication, and teamwork
- Develop teamwork and collaboration skills through group projects and presentations
- Develop time management and organizational skills through planning and executing research projects
- Develop problem-solving and analytical skills that can be applied to a range of fields

Course Topics:

1. Introduction to Research
    - Understanding the concept of research
2. Research Methodology: An Introduction
    - Objectives of research
    - Types of research
    - Approaches to research
    - Significance of research
3. Reviewing the Literature
    - The functions of literature review in research
    - Conducting a literature search
    - Reviewing selected literature
    - Developing theoretical and conceptual frameworks
4. Writing Protocol

- Precautions for writing research proposal
- Identifying problems and limitations of the study
- Setting a proposed time-frame for the project
- Addressing ethical issues
- Preventing plagiarism
- Referencing and writing a bibliography

5. Formulating a Research Problem and Research Question

   - Identifying sources of research problems
   - Selecting a research problem
   - Steps in formulating a research problem
   - Developing research objectives

6. Ethics in Research
7. Introduction to Epidemiology

   - Understanding the concept of epidemiology

8. Measurement Tools in Epidemiology

   - Validity and reliability of measurement tools in epidemiology
   - Common types of measurement tools used in epidemiological studies (e.g., surveys, questionnaires, biomarkers)
   - Issues related to measurement error and bias in epidemiological studies

9. Descriptive Studies

   - Types of descriptive studies (e.g., cross-sectional, ecological)
   - Uses and limitations of descriptive studies in epidemiological research
   - Methods for analyzing and presenting descriptive data in epidemiological studies

10. Case-Control Studies

    - Basic principles and design of case-control studies
    - Sampling strategies for case-control studies
    - Strengths and weaknesses of case-control studies in epidemiological research

11. Cohort Studies

- Basic principles and design of cohort studies
- Types of cohorts (e.g., prospective, retrospective)
- Advantages and disadvantages of cohort studies in epidemiological research

12. Questionnaire Design

- Importance of questionnaire design in epidemiological research
- Common types of questions used in questionnaires
- Strategies for assessing the validity and reliability of questionnaires

13. Medical Reading and Writing

- Reading and interpreting medical literature
- Strategies for effective medical writing
- Ethical considerations in medical writing and publication

14. Structure of a Medical Research Paper

- Elements of a research paper (e.g., introduction, methods, results, discussion)
- Writing styles and formatting for medical research papers
- Tips for effective scientific writing and publication

15. Screening

- Principles of screening in epidemiology
- Types of screening tests and their characteristics (e.g., sensitivity, specificity)
- Evaluation of screening programs in epidemiology

16. Association and Causation

- Concepts of association and causation in epidemiology
- Criteria for establishing causality in epidemiological research
- Confounding and effect modification in epidemiological studies

17. Basic Concepts and Definitions in Statistics

- Types of variables in statistics (e.g., categorical, continuous)
- Measures of central tendency and variability
- Probability distributions and hypothesis testing in epidemiology

8. Selecting a Method of Data Collection

- Differences in methods of data collection in quantitative and qualitative research
- Collecting data using primary sources
- Observation
- Interviews

19. Descriptive Statistics

- Measures of central tendency
- Measures of variability
- Frequency distributions

20. Inferential Statistics and Significant Test

- Hypothesis testing
- Type I and Type II errors
- Confidence intervals

21. The Use of Excel and SPSS

- Data entry and cleaning
- Data manipulation and transformation
- Data visualization and presentation

22. Research Proposal Projects

- Identifying research gaps
- Formulating research questions and hypotheses
- Structuring a research proposal
- Designing a research methodology

Tutorial Classes:

1. Introduction to Research Methodology and Data Analysis course

- Objectives of the course
- Course requirements and expectations
- Overview of the course topics

2. Literature Search and Review

- Strategies for conducting a literature search
- Critical appraisal of research articles
- Synthesizing information from different sources

3. Writing a Research Proposal

- Components of a research proposal
- Tips for writing an effective proposal
- Ethical considerations in research proposal writing

4. Formulating a Research Question

- Importance of a research question
- Characteristics of a good research question
- Developing research objectives from research questions

5. Research Ethics

- Overview of ethical principles in research
- Ethical issues in biomedical research
- Ensuring ethical conduct in research

6. Descriptive Statistics

- Types of descriptive statistics
- Measures of central tendency
- Measures of variability

7. Inferential Statistics and Significance Testing

- Types of inferential statistics
- Hypothesis testing and p-values
- Understanding statistical significance

8. Epidemiology Concepts and Measurements

- Overview of epidemiology
- Types of epidemiological studies
- Epidemiological measures of disease frequency

9. Questionnaire Design

- Importance of questionnaire design in research
- Principles of questionnaire design
- Common pitfalls to avoid in questionnaire design

10. Research Proposal Presentations

- Tips for effective research proposal presentations
- Peer-review of research proposals
- Feedback and discussion of research proposals

Objectives for Each Tutorial Class:

1. Students will be introduced to the course and its objectives, as well as expectations for the course.
2. Students will learn how to conduct a literature search, critically appraise research articles, and synthesize information from different sources.
3. Students will understand the components of a research proposal, how to write an effective proposal, and ethical considerations in research proposal writing.
4. Students will learn how to formulate a research question, characteristics of a good research question, and how to develop research objectives from research questions.
5. Students will understand the ethical principles in research, ethical issues in biomedical research, and how to ensure ethical conduct in research.
6. Students will learn the different types of descriptive statistics, measures of central tendency, and measures of variability.
7. Students will understand the types of inferential statistics, hypothesis testing and p-values, and the concept of statistical significance.
8. Students will learn about epidemiology, types of epidemiological studies, and epidemiological measures of disease frequency.
9. Students will understand the importance of questionnaire design in research, principles of questionnaire design, and common pitfalls to avoid.
10. Students will learn how to present a research proposal effectively, peer-review other students' research proposals, and receive feedback on their own research proposals.

References:

1. Dawson, C. (2009). Introduction to research methods: A practical guide for anyone undertaking a research project. How To Books Ltd.
2. Gliner, J. A., Morgan, G. A., & Leech, N. L. (2011). Research methods in applied settings: An integrated approach to design and analysis. Routledge.
3. Kumar, R. (2014). Research Methodology: A Step-by-Step Guide for Beginners. Sage Publications.

9	Course title: Specimen Procurement and Documentation	Course Code: MLSC-307

Overall Description and Aims:

The course is designed to provide students with the knowledge and practical skills necessary for the collection, handling, and documentation of specimens in a clinical laboratory setting. The course will cover a range of topics related to the proper handling and processing of biological specimens, including blood, urine, stool, and tissue samples. The aim of the course is to prepare students for careers in clinical laboratory science by providing them with a strong foundation in the theory and practice of specimen procurement and documentation.

Intended Learning Outcomes:

Upon completion of this course, students will have acquired:

Knowledge and Understanding:

- An understanding of the principles and methods used in the collection, handling, and documentation of biological specimens
- Knowledge of the different types of specimens and their unique handling requirements
- An understanding of the role of the clinical laboratory in the healthcare system
- Knowledge of the ethical and legal considerations surrounding the handling of biological specimens

Intellectual Skills:

- Analyze and interpret laboratory data
- Apply critical thinking to specimen collection and handling
- Evaluate quality assurance and control techniques in the laboratory

Professional and Practical Skills:

- The ability to safely and accurately collect, handle, and document biological specimens
- The ability to use and maintain laboratory equipment related to specimen procurement and documentation
- The ability to communicate effectively with healthcare professionals and laboratory staff

- Demonstrate proper techniques for specimen procurement and documentation
- Practice occupational health and safety measures in the laboratory
- Apply quality assurance and control techniques in the laboratory

General Transferable Skills:

- Communicate effectively in a laboratory setting
- Work effectively as part of a team
- Develop time management and organizational skills

Course Topics:

1. Introduction to Specimen Procurement and Documentation

- Understand the importance of proper specimen procurement and documentation in the clinical laboratory setting.

2. Types of Specimens

- Identify different types of specimens and their unique handling requirements.

3. Patient Identification and Specimen Labeling

- Understand the importance of accurate patient identification and specimen labeling.

4. Specimen Collection and Handling

- Identify proper techniques for the collection and handling of different types of specimens.

5. Specimen Transport and Storage

- Understand the requirements for specimen transport and storage.

6. Quality Assurance and Control

- Understand the importance of quality assurance and control in specimen procurement and documentation.

7. Occupational Health and Safety

- Identify and understand the hazards associated with specimen procurement and documentation and the measures used to protect laboratory staff.

8. Legal and Ethical Issues

- Understand the legal and ethical considerations surrounding the handling of biological specimens.

9. Point of Care Testing

- Understand the principles of point-of-care testing and its impact on specimen procurement and documentation.

10. Clinical Laboratory Workflow

- Understand the role of specimen procurement and documentation in the clinical laboratory workflow.

11. Laboratory Information Systems

- Understand the role of laboratory information systems in specimen procurement and documentation.

13. Hematology

- Understand the principles of hematology and the techniques used to collect and analyze blood specimens.

3. Venipuncture: Demonstrate proper techniques for venipuncture

4. Capillary Blood Collection: Demonstrate proper techniques for capillary blood collection

14. Microbiology

- Understand the principles of microbiology and the techniques used to collect and analyze various microbiological specimens.

15. Clinical Chemistry

- Understand the principles of clinical chemistry and the techniques used to collect and analyze various biochemical specimens.

16. Urinalysis

- Understand the principles of urinalysis and the techniques used to collect and analyze urine specimens.

17. Immunology and Serology

- Understand the principles of immunology and serology and the techniques used to collect and analyze various immunological and serological specimens.

18. Cytology and Histology

- Understand the principles of cytology and histology and the techniques used to collect and analyze various tissue specimens.

19. Specimen Rejection and Unsatisfactory Samples

- Understand and practice techniques for specimen rejection and documentation of unsatisfactory samples

20. Specimen Referral and External Testing

- Understand the process of specimen referral and external testing

21. Newborn Screening

- Understand and practice proper techniques for newborn screening

22. Specimen Collection in Special Populations

- Understand and practice proper techniques for specimen collection in special populations, such as pediatric, geriatric, and critically ill patients

23. Molecular Diagnostics

- Understand and practice proper techniques for collecting and analyzing various molecular specimens

24. Hematopoietic Stem Cell Collection and Processing

- Understand and practice proper techniques for collecting and processing hematopoietic stem cells.

25. Blood Transfusion

- Understand and practice proper techniques for blood transfusion and blood bank specimen collection

26. Collection of Specimens for Drug Monitoring and Toxicology

- Understand and practice proper techniques for collecting specimens for drug monitoring and toxicology testing

27. Specimen Collection and Transport in Public Health

- Understand and practice proper techniques for specimen collection and transport in public health settings

28. Quality Improvement in Specimen Procurement and Documentation

- Understand and apply quality improvement techniques in the laboratory to enhance specimen procurement and documentation processes

29. Emerging Technologies in Specimen Procurement and Documentation

- Understand and apply emerging technologies in specimen procurement and documentation processes to improve efficiency and accuracy

Practical Classes:

1. Patient Identification and Specimen Labeling

- Practice proper techniques for patient identification and specimen labeling

2. Venipuncture

- Practice proper techniques for venipuncture

3. Capillary Blood Collection

- Practice proper techniques for capillary blood collection

4. Specimen Transport and Storage

- Practice proper techniques for specimen transport and storage

5. Quality Assurance and Control
- Apply quality assurance and control techniques in the laboratory

6. Occupational Health and Safety
7. Practice occupational health and safety measures in the laboratory

7. Point of Care Testing

- Practice point-of-care testing techniques

8. Clinical Laboratory Workflow
9. Apply proper techniques for specimen procurement and documentation in a simulated clinical laboratory setting

9. Hematology

- Practice proper techniques for collecting and analyzing blood specimens

10. Microbiology
11. Practice proper techniques for collecting and analyzing various microbiological specimens

11. Clinical Chemistry

- Practice proper techniques for collecting and analyzing various biochemical specimens

12. Urinalysis
13. Practice proper techniques for collecting and analyzing urine specimens
14. Immunology and Serology
15. Practice proper techniques for collecting and analyzing various immunological and serological specimens
16. Cytology and Histology
17. Practice proper techniques for collecting and analyzing various tissue specimens

15. Forensic Specimen Collection

- Practice proper techniques for forensic specimen collection and documentation

16. Specimen Rejection and Unsatisfactory Samples

- Practice techniques for specimen rejection and documentation of unsatisfactory samples

17. Specimen Referral and External Testing

- Understand the process of specimen referral and external testing

18. Newborn Screening

- Practice proper techniques for newborn screening

19. Specimen Collection in Special Populations

- Practice proper techniques for specimen collection in special populations, such as pediatric, geriatric, and critically ill patients

20. Cytology and Histology

- Practice proper techniques for collecting and analyzing various tissue specimens.

References:

1. Nester, E. W., Anderson, D. G., Roberts, C. E., & Nester, M. T. (2012). Microbiology: a human perspective. McGraw-Hill Education.
2. Kaplan, L. A., & Pesce, A. J. (2018). Clinical chemistry: theory, analysis, correlation. Elsevier.
3. Bishop M, Fody E, Schoeff L. Clinical Chemistry: Principles, Techniques, Correlations. Lippincott Williams & Wilkins, 2017.
4. Clinical and Laboratory Standards Institute (CLSI). Collection, Transport, and Processing of Blood Specimens for Testing Plasma-Based Coagulation Assays and Molecular Hemostasis Assays; Approved Guideline, 5th Ed. CLSI document H21-A5. Wayne, PA: Clinical and Laboratory Standards Institute, 2008.

Department of Molecular Diagnostics

Proposed Syllabi for all Courses In the Fourth Year



Prepared by

Abdelmuhsen Abusneina, PhD

March 9, 2023

Syllabus of Fourth Year Courses

1	Course title: Biomedical Ethics and Scientific Integrity	Course Code: BMSC-401

Overall Description and Aims:

The undergraduate course in Biomedical Ethics and Scientific Integrity is designed to provide students with a comprehensive understanding of the ethical issues that arise in biomedical research and practice, as well as the importance of scientific integrity in the field. The course will explore a range of ethical frameworks and principles, and apply them to real-world scenarios in order to develop critical thinking skills and promote ethical decision-making.

Aims of the Course:

1. To introduce students to the fundamental principles of biomedical ethics and scientific integrity, and the importance of these principles in the biomedical sciences.
2. To develop students' critical thinking skills, and their ability to analyze complex ethical issues that arise in biomedical research and practice.
3. To promote ethical decision-making skills in students, and to provide them with the tools necessary to navigate ethical dilemmas that may arise in their future careers in the biomedical sciences.

Intended Learning Outcomes:

By the end of this course, students should be able to:

Knowledge and Understanding:

1. Demonstrate a broad knowledge of the fundamental principles of biomedical ethics and scientific integrity.
2. Describe the ethical frameworks and principles that are commonly used in biomedical research and practice.
3. Analyze and evaluate ethical issues that arise in biomedical research and practice, using a range of ethical frameworks and principles.

Intellectual Skills:

1. Critically analyze and evaluate complex ethical issues that arise in biomedical research and practice.

2. Develop and present well-reasoned arguments to support ethical decision-making.

Professional and Practical Skills:

1. Apply ethical frameworks and principles to real-world scenarios in the biomedical sciences.
2. Demonstrate effective communication skills in discussing ethical issues with colleagues and other stakeholders in the field.

Course topics

1: Introduction to Biomedical Ethics and Scientific Integrity

- Overview of the course goals, expectations, and assignments
- Introduction to ethical principles and theories in biomedical research and clinical practice
- Importance of maintaining scientific integrity in research

2: Autonomy and Informed Consent

- Explanation of the principle of autonomy and its role in healthcare decision-making
- Overview of informed consent and its requirements for ensuring patient understanding and choice

3: Beneficence and Non-Maleficence

- Discussion of the ethical principles of doing good (beneficence) and avoiding harm (non-maleficence)
- Case studies and scenarios exploring the ethical balancing of these principles in clinical practice and research

4: Justice and Fairness

- Introduction to the principle of justice and its application in healthcare and biomedical research
- Exploration of the concept of distributive justice and its implications for healthcare resource allocation

5: Confidentiality and Privacy

- Overview of the legal and ethical requirements for protecting patient information
- Discussion of the consequences of breaching confidentiality and privacy in healthcare and biomedical research

6: End-of-Life Issues

- Explanation of the ethical issues surrounding end-of-life care, including euthanasia and palliative care
- Discussion of advance directives and their role in promoting patient autonomy in end-of-life decision-making

8: Animal Research Ethics

- Exploration of the ethical issues involved in using animals in biomedical research
- Introduction to the principles of animal research ethics, including the 3Rs (replace, reduce, refine) and the role of animal care and use committees (ACUCs)

9: Ethics of Genetic Testing and Gene Editing

- Discussion of the ethical issues involved in genetic testing and gene editing, including the potential benefits and risks of these technologies
- Exploration of the ethical considerations involved in using gene editing technology

10: Clinical Trials

- Overview of the ethical issues involved in conducting clinical trials, including the principles of informed consent and the use of placebos
- Exploration of the selection of study participants and other ethical considerations in clinical trial design

11: Organ Donation and Transplantation

- Introduction to the ethical issues involved in organ donation and transplantation
- Discussion of the allocation of organs, the ethics of living organ donation, and the use of genetic testing in donor selection

12: Public Health Ethics

- Introduction to the ethical issues involved in public health practice and policy, such as vaccination programs and health emergency responses
- Discussion of the ethical principles of autonomy, beneficence, non-maleficence, and justice in public health decision-making

13: Reproductive Ethics

- Exploration of the ethical issues involved in reproductive health and technology, such as contraception, abortion, and in vitro fertilization (IVF)
- Discussion of the ethical considerations involved in the use of reproductive technologies, including the selection of embryos and the use of donor gametes

14: Disability Ethics

- Introduction to the ethical issues involved in the diagnosis, treatment, and care of people with disabilities
- Discussion of the ethical principles of respect for persons, beneficence, and justice in disability ethics

15: End-of-Life Ethics and Decision-Making

- Exploration of the ethical issues involved in end-of-life decision-making, including the withdrawal of life-sustaining treatment and the use of palliative care
- Discussion of the ethical considerations involved in advance care planning and end-of-life decision-making

16: Technology and Privacy Ethics

- Exploration of the ethical issues involved in the use of technology in healthcare, including electronic health records and telemedicine
- Discussion of the ethical considerations involved in the use of personal data and privacy protection in the context of technology in healthcare

17: Ethics of Innovation and Entrepreneurship in Biomedicine

- Exploration of the ethical issues involved in innovation and entrepreneurship in biomedicine, including intellectual property, conflicts of interest, and the potential impact on patient care
- Discussion of the ethical considerations involved in the translation of research and development into clinical practice and commercial applications.

18: Introduction to Scientific Integrity

- Definition and importance of scientific integrity
- Historical cases of scientific misconduct and their impact on scientific research

19: Research Design and Data Collection

- Ethical considerations in research design, such as informed consent, study design, and data collection methods
- Data management, data sharing, and data ownership

20: Data Analysis and Interpretation

- Ethical considerations in data analysis and interpretation, such as statistical significance, data manipulation, and data fabrication
- Responsible reporting of research findings

21: Authorship and Publication

- Ethical considerations in authorship, such as authorship criteria, conflicts of interest, and ghostwriting
- Ethical considerations in publication, such as peer review, editorial policies, and plagiarism

22: Collaboration and Mentoring

- Ethical considerations in scientific collaboration, such as authorship credit, data sharing, and communication
- Ethical considerations in mentoring, such as supervision, training, and responsible conduct of research

23: Conflicts of Interest and Professional Responsibility

- Types of conflicts of interest and their impact on scientific integrity
- Ethical responsibilities of researchers, such as reporting of conflicts of interest and ethical violations

24: Scientific Integrity and Research Misconduct

- Explanation of the principles of scientific integrity and the consequences of research misconduct
- Definition and types of research misconduct

- Ethical considerations in whistleblowing, such as reporting mechanisms, protection of whistleblowers, and ethical considerations in the reporting process
- Discussion of the different forms of research misconduct and their impact on the individual researcher and the scientific community

25: Scientific Integrity and Society

- The role of scientific integrity in society, such as trust in science, funding of research, and public perception of scientific research
- Scientific integrity in the context of emerging fields and technologies

26: Research Ethics

- Overview of the principles of research ethics, including respect for persons, beneficence, and justice
- Discussion of the role of institutional review boards (IRBs) in protecting research participants

27: International Perspectives on Scientific Integrity

- Comparison of scientific integrity standards across countries and cultures
- Ethical considerations in international collaborations and research projects

References:

1. Beauchamp, T.L. and Childress, J.F., Principles of Biomedical Ethics, 8th ed. New York: Oxford University Press, 2019.
2. National Academy of Sciences, National Academy of Engineering, and Institute of Medicine. On Being a Scientist: A Guide to Responsible Conduct in Research, 3rd ed. Washington, DC: The National Academies Press, 2009.

2	Course title: Diagnostic Genetics	Course Code: MOLD-401

Overall Description and Aims:

The course is designed to provide students with a comprehensive understanding of the principles and applications of genetic testing and diagnosis. The course aims to equip students with the knowledge, skills, and practical experience necessary to evaluate, interpret, and communicate genetic information to healthcare professionals, patients, and their families. The course will cover topics such as genetic testing technologies, genetic counseling, and ethical considerations in genetic testing.

Intended Learning Outcomes:

Upon completion of this course, students will have developed the following competencies:

Knowledge and Understanding:

1. Understand the basic principles of genetic testing and diagnosis.
2. Describe the different technologies used in genetic testing and their limitations.
3. Explain the significance of genetic counseling and its role in the genetic testing process.
4. Understand the ethical and legal considerations associated with genetic testing.

Intellectual Skills:

1. Critically evaluate genetic testing results and their implications.
2. Apply theoretical knowledge to solve practical problems in genetic testing.
3. Develop research skills to design and conduct genetic studies.

Professional and Practical Skills:

1. Communicate genetic information effectively to healthcare professionals, patients, and families.
2. Apply best practices in genetic testing to ensure accuracy, precision, and quality.
3. Use specialized software and databases for genetic data analysis.

General Transferable Skills:

1. Develop critical thinking, analytical, and problem-solving skills.

2. Communicate complex information effectively to different audiences.
3. Develop teamwork, leadership, and time-management skills.

Course Topics:

1. Introduction to Diagnostic Genetics: Understand the scope and importance of diagnostic genetics.
2. Principles of Inheritance: Understand the basic principles of Mendelian and non-Mendelian inheritance.
3. Genetic Testing Technologies: Describe the different technologies used in genetic testing and their advantages and disadvantages.
4. Genetic Counseling: Understand the significance of genetic counseling and the skills required for effective counseling.
5. Pre- and Post-Test Counseling: Understand the importance of pre- and post-test counseling for genetic testing.
6. Genetic Testing in Clinical Practice: Understand the applications and limitations of genetic testing in clinical practice.
7. Chromosomal Abnormalities: Understand the types and clinical significance of chromosomal abnormalities.
8. Single Gene Disorders: Understand the genetic basis, clinical manifestations, and management of single gene disorders.
9. Mitochondrial Disorders: Understand the genetic basis, clinical manifestations, and management of mitochondrial disorders.
10. Complex Disorders: Understand the genetic basis and risk factors of complex disorders.
11. Pharmacogenomics: Understand the role of pharmacogenomics in personalized medicine.
12. Ethical and Legal Considerations in Genetic Testing: Understand the ethical and legal issues associated with genetic testing.
13. Prenatal Diagnosis: Understand the different techniques used for prenatal diagnosis and their indications and limitations.
14. Newborn Screening: Understand the principles and applications of newborn screening.
15. Cancer Genetics: Understand the genetic basis, clinical implications, and management of cancer genetics.
16. Genomics and Personalized Medicine: Understand the role of genomics and personalized medicine in healthcare.
17. Epigenetics: Understand the role of epigenetics in gene expression and disease.
18. Gene Therapy: Understand the principles and applications of gene therapy.

19. Next-Generation Sequencing: Understand the principles and applications of next-generation sequencing in genetic testing.

Practical Classes and Objectives:

1. DNA Extraction: Understand the principles and techniques of DNA extraction.
2. PCR: Understand the principles and applications of PCR.
3. Gel Electrophoresis: Understand the principles and applications of gel electrophoresis.
4. Sanger Sequencing: Understand the principles and applications of Sanger sequencing.
5. Next-Generation Sequencing: Understand the principles and applications of next-generation sequencing.
6. Mutation Detection: Understand the principles and techniques of mutation detection.
7. 7. Chromosome Analysis: Understand the principles and applications of chromosome analysis.
8. FISH: Understand the principles and applications of FISH.
9. Microarray Analysis: Understand the principles and applications of microarray analysis.
10. Gene Expression Analysis: Understand the principles and applications of gene expression analysis.
11. Variant Interpretation: Understand the principles and techniques of variant interpretation.
12. Quality Control in Genetic Testing: Understand the principles and techniques of quality control in genetic testing.
13. Genetic Counseling: Develop the skills required for effective genetic counseling.
14. Case Studies: Apply theoretical knowledge to solve practical problems in genetic testing.
15. Research Methods: Develop research skills to design and conduct genetic studies.
16. Data Analysis: Use specialized software and databases for genetic data analysis.
17. Clinical Interpretation: Critically evaluate genetic testing results and their implications.
18. Reporting and Communication: Communicate genetic information effectively to healthcare professionals, patients, and families.
19. Laboratory Management: Apply best practices in genetic testing to ensure accuracy, precision, and quality.

References:

1. Nussbaum RL, McInnes RR, Willard HF. Genetics in Medicine. Elsevier Health Sciences; 2020.
2. Harper PS, Clarke AJ. Genetics, Society, and Clinical Practice. Oxford University Press; 2015.

3	Course title: Infection Control and Safety	Course Code: BMSC-402

Overall Description and Aims:

The course is designed to provide students with an understanding of the principles of infection control and safety in healthcare settings. The course aims to equip students with the knowledge and skills necessary to prevent and control infections, protect themselves and patients from hazards, and promote safe and healthy work environments. The course will cover a range of topics, including infection control practices, occupational health and safety, emergency preparedness, and risk assessment.

Intended Learning Outcomes:

Knowledge and Understanding:

- Demonstrate a comprehensive understanding of the principles of infection control and safety.
- Identify the different types of infections and their modes of transmission.
- Explain the role of healthcare professionals in preventing and controlling infections.
- Describe the principles of occupational health and safety in healthcare settings.
- Understand the principles of emergency preparedness in healthcare settings.

Intellectual Skills:

- Evaluate the effectiveness of infection control practices in healthcare settings.
- Analyze and assess the risks associated with healthcare practices.
- Develop strategies to prevent and control infections in healthcare settings.
- Develop emergency preparedness plans for healthcare settings.
- Interpret and analyze infection control policies and procedures.

Professional and Practical Skills:

- Apply infection control practices in healthcare settings.
- Use appropriate personal protective equipment in healthcare settings.
- Conduct risk assessments in healthcare settings.
- Develop and implement infection control policies and procedures.
- Communicate effectively with colleagues and patients about infection control practices.

General Transferable Skills:

- Develop critical thinking skills.
- Work effectively in teams.
- Develop problem-solving skills.
- Improve time management skills.
- Develop effective communication skills.

Course Topics:

1. Introduction to Infection Control and Safety

- Define the principles of infection control and safety in healthcare settings.
- Identify the different types of infections and their modes of transmission.
- Explain the role of healthcare professionals in preventing and controlling infections.

2. Infection Control Practices

- Describe the principles of infection control practices in healthcare settings.
- Identify the different types of infection control practices.
- Evaluate the effectiveness of infection control practices in healthcare settings.

3. Personal Protective Equipment (PPE)

- Define the principles of personal protective equipment in healthcare settings.
- Identify the different types of PPE.
- Use appropriate PPE in healthcare settings.

4. Hand Hygiene

- Define the principles of hand hygiene in healthcare settings.
- Identify the different types of hand hygiene.
- Apply appropriate hand hygiene techniques in healthcare settings.

5. Environmental Cleaning and Disinfection

- Define the principles of environmental cleaning and disinfection in healthcare settings.
- Identify the different types of environmental cleaning and disinfection.
- Apply appropriate environmental cleaning and disinfection techniques in healthcare settings.

6. Sterilization and Disinfection of Medical Devices

- Define the principles of sterilization and disinfection of medical devices.
- Identify the different types of sterilization and disinfection techniques.
- Apply appropriate sterilization and disinfection techniques in healthcare settings.

7. Infection Prevention and Control in Special Situations

- Define the principles of infection prevention and control in special situations.
- Identify the different types of special situations.
- Apply appropriate infection prevention and control measures in special situations.

8. Occupational Health and Safety

- Describe the principles of occupational health and safety in healthcare settings.
- Identify the different types of occupational hazards in healthcare settings.
- Develop strategies to prevent and control occupational hazards in healthcare settings.

9. Emergency Preparedness

- Define the principles of emergency preparedness in healthcare settings.
- Identify the different types of emergencies in healthcare settings.
- Develop emergency preparedness plans for healthcare settings.

10. Risk Assessment

- Define the principles of risk assessment in healthcare settings.
- Identify the different types of risks in healthcare settings.
- Conduct risk assessments in healthcare settings.

11. Healthcare-Associated Infections (HAIs)

- Define healthcare-associated infections (HAIs).
- Identify the different types of HAIs.
- Develop strategies to prevent and control HAIs in healthcare settings.

12. Outbreak Management

- Define outbreak management in healthcare settings.

- Identify the different types of outbreaks.
- Develop outbreak management plans for healthcare settings.

13. Communicable Diseases

- Define communicable diseases.
- Identify the different types of communicable diseases.
- Develop strategies to prevent and control communicable diseases in healthcare settings.

14. Immunization and Vaccination

- Define the principles of immunization and vaccination.
- Identify the different types of vaccines.
- Develop immunization and vaccination plans for healthcare settings.

15. Infectious Waste Management

- Define the principles of infectious waste management.
- Identify the different types of infectious waste.
- Develop infectious waste management plans for healthcare settings.

16. Emerging Infectious Diseases

- Define emerging infectious diseases.
- Identify the different types of emerging infectious diseases.
- Develop strategies to prevent and control emerging infectious diseases in healthcare settings.

17. Infection Control Policies and Procedures

- Define infection control policies and procedures.
- Identify the different types of infection control policies and procedures.
- Develop and implement infection control policies and procedures in healthcare settings.

18. Infection Control Auditing and Surveillance

- Define infection control auditing and surveillance.
- Identify the different types of infection control audits and surveillance.
- Develop infection control auditing and surveillance plans for healthcare settings.

21. Management of Infectious Diseases

- Define the principles of management of infectious diseases.
- Identify the different types of infectious diseases.
- Develop management plans for infectious diseases in healthcare settings.

22. Infection Control in the Community

- Define the principles of infection control in the community.
- Identify the different types of community infection control.
- Develop strategies to prevent and control community infections.

23. Infection Control in Outpatient Settings

- Define the principles of infection control in outpatient settings.
- Identify the different types of outpatient infection control.
- Develop infection control plans for outpatient settings.

24. Infection Control in Long-Term Care Facilities

- Define the principles of infection control in long-term care facilities.
- Identify the different types of infection control in long-term care facilities.
- Develop infection control plans for long-term care facilities.

25. Infection Control in the Laboratory

- Define the principles of infection control in the laboratory.
- Identify the different types of infection control in the laboratory.
- Develop infection control plans for laboratory settings.

27. Infection Control Program Evaluation

- Define infection control program evaluation.
- Identify the different types of infection control program evaluation.
- Develop infection control program evaluation plans.

28. Infection Control in a Pandemic

- Define the principles of infection control in a pandemic.
- Identify the different types of pandemics.
- Develop infection control plans for pandemics.

References:

1. Weber, D. J., & Rutala, W. A. (2013). Understanding and preventing transmission of healthcare-associated infections. Infection Control & Hospital Epidemiology, 34(8), 781-786.
2. Zelman, M., & Milne-Zelman, C. (2017). Infection Control and Safety (1st ed.). Jones & Bartlett Learning
3. Centers for Disease Control and Prevention (CDC). (2009). Guidelines for infection control in healthcare personnel, 1998. Recommendations of the Advisory Committee on Immunization Practices (ACIP) and the Hospital Infection Control Practices Advisory Committee (HICPAC). MMWR. Recommendations and reports: Morbidity and mortality weekly report. Recommendations and reports, 48(RR-6), 1-37.

4	Course title: Molecular Diagnostic of Hematopathology and Oncology	Course Code: MOLD-402

Overall Description and Aims:

The course aims to provide students with a detailed understanding of the molecular basis of hematopathology and oncology, and the practical skills required for molecular diagnostic testing. The course will focus on the techniques used in the diagnosis of hematologic malignancies and solid tumors, including the identification of genetic and epigenetic alterations, and the analysis of gene expression patterns. The course will also cover the principles of personalized medicine and the development of targeted therapies.

Intended Learning Outcomes: By the end of the course, students should be able to:

Knowledge and Understanding:

- Understand the molecular basis of hematopathology and oncology
- Identify the genetic and epigenetic alterations associated with hematologic malignancies and solid tumors
- Analyze gene expression patterns and identify gene mutations
- Understand the principles of personalized medicine and the development of targeted therapies
- Demonstrate an understanding of the principles and methods of molecular diagnostic testing in hematopathology and oncology
- Analyze and interpret molecular diagnostic data

Intellectual Skills:

- Critically evaluate scientific literature related to hematopathology and oncology

Professional and Practical Skills:

- Operate and troubleshoot molecular diagnostic equipment
- Perform quality control and quality assurance measures
- Interpret and report molecular diagnostic results

General Transferable Skills:

- Work effectively in a team

- Communicate scientific concepts effectively to diverse audiences
- Organize and manage time effectively

Course Topics:

1. Introduction to molecular diagnostics in hematopathology and oncology: Understand the principles and methods of molecular diagnostic testing in hematopathology and oncology
2. Hematopathology and oncology: An overview
3. Molecular genetics and cancer
4. Epigenetics and cancer
5. Tumor microenvironment and cancer
6. Tumor suppressor genes and oncogenes
7. Cell cycle control and cancer
8. Signal transduction and cancer
9. DNA damage and repair
10. Molecular pathology of hematologic malignancies
11. Molecular pathology of solid tumors
12. Techniques for the detection of gene mutations
13. Techniques for the detection of gene expression patterns
14. Techniques for the detection of DNA methylation
15. Techniques for the detection of chromosomal abnormalities
16. Personalized medicine and targeted therapies
17. Clinical trials in molecular oncology
18. Molecular diagnostic challenges and limitations
19. Hematologic malignancies: overview and classification Objective: Understand the classification and diagnosis of hematologic malignancies
20. Acute myeloid leukemia (AML) Objective: Understand the molecular diagnosis and treatment of AML
21. Acute lymphoblastic leukemia (ALL) Objective: Understand the molecular diagnosis and treatment of ALL
22. Chronic myeloid leukemia (CML) Objective: Understand the molecular diagnosis and treatment of CML
23. Chronic lymphocytic leukemia (CLL) Objective: Understand the molecular diagnosis and treatment of CLL
24. Non-Hodgkin lymphoma (NHL) Objective: Understand the molecular diagnosis and treatment of NHL
25. Hodgkin lymphoma (HL) Objective: Understand the molecular diagnosis and treatment of HL

26. Multiple myeloma (MM) Objective: Understand the molecular diagnosis and treatment of MM
27. Solid tumors: overview and classification Objective: Understand the classification and diagnosis of solid tumors
28. Breast cancer Objective: Understand the molecular diagnosis and treatment of breast cancer
29. Lung cancer Objective: Understand the molecular diagnosis and treatment of lung cancer
30. Colorectal cancer Objective: Understand the molecular diagnosis and treatment of colorectal cancer
31. Other solid tumors Objective: Understand the molecular diagnosis and treatment of other solid tumors

Practical Classes:

1. Introduction to molecular diagnostic laboratory equipment: Understand the operation and function of molecular diagnostic laboratory equipment;
2. Sample preparation and DNA extraction:
3. PCR amplification and gel electrophoresis
4. Real-time PCR
5. DNA sequencing
6. SNP genotyping
7. Gene expression analysis using microarrays 8. Gene expression analysis using RNA sequencing
9. DNA methylation analysis using bisulfite sequencing
10. Chromosomal analysis using karyotyping and FISH
11. Analysis of circulating tumor cells and cell-free DNA
12. Quality control and quality assurance in molecular diagnostic testing
13. Interpretation and reporting of molecular diagnostic results
14. Introduction to personalized medicine and targeted therapies
15. Bioinformatics analysis of molecular diagnostic data
16. Clinical trial design and implementation in molecular oncology
17. Critical evaluation of scientific literature in molecular oncology
18. Ethics in molecular oncology research
19. Case studies in molecular diagnostic testing

References:

1. B. A. Bernstein and J. L. Johnson, eds., Molecular Diagnostics in Hematological Malignancies (Humana Press, 2018).

2. G. J. Tsongalis, ed., Molecular Pathology: The Molecular Basis of Human Disease (Academic Press, 2018).
3. Skotheim, R. I., & Bjørnslett, M. (2018). Molecular diagnostics of solid tumors: quo vadis? Molecular oncology, 12(12), 1853-1855.
4. Santonocito, C., Capra, M., Ajmone, P., & Pravettoni, G. (2021). Molecular Diagnosis in Hematopathology: New Insights and Perspectives. Frontiers in molecular biosciences, 8, 662561.

5	Course title: Molecular Diagnostic of Infectious Diseases	Course Code: MOLD-403

Overall Description and Aims:

The course will provide students with a comprehensive understanding of various molecular diagnostic techniques, including real-time PCR, next-generation sequencing, and microarray technology, as well as immunological and serological methods used in the diagnosis of infectious diseases. The course will also cover quality control, sample handling, and storage, and global health issues related to infectious diseases.

The aim of the course is to equip students with the necessary knowledge and practical skills required to work in a clinical laboratory and to make informed decisions regarding the selection and interpretation of appropriate diagnostic tests for the diagnosis and management of infectious diseases.

Intended Learning Outcomes of Course:

Knowledge and Understanding:

1. Understand the principles and concepts of molecular diagnostics of infectious diseases.
2. Identify the different types of molecular techniques used in the diagnosis of infectious diseases.
3. Understand the interpretation of molecular diagnostic results.
4. Understand the principles and techniques used in molecular diagnostics of infectious diseases.
5. Understand the various molecular diagnostic methods used to identify and diagnose infectious diseases.
6. Understand the clinical applications of molecular diagnostics in infectious diseases.
7. Analyze and interpret molecular diagnostic results in a clinical setting.

Intellectual Skills:

- Apply critical thinking and problem-solving skills to molecular diagnostic techniques and their application in the diagnosis of infectious diseases.
- Analyze and interpret molecular diagnostic results in a clinical setting.
- Evaluate the performance of diagnostic tests and make informed decisions regarding the selection and interpretation of appropriate tests.

Professional and Practical Skills:

1. Demonstrate practical skills in molecular diagnostic techniques used in the diagnosis of infectious diseases.
2. Design and execute experimental protocols to optimize molecular diagnostic methods.
3. Work collaboratively in a laboratory environment.

General Transferable Skills:

1. Communicate effectively through written and oral presentations.
2. Analyze and interpret scientific data.

Course Topics and Objectives:

1. Introduction to Molecular Diagnostics: Understand the principles and concepts of molecular diagnostics of infectious diseases.
2. Nucleic Acid Extraction Techniques: Identify different nucleic acid extraction techniques and their applications.
3. Polymerase Chain Reaction (PCR): Understand the principles and applications of PCR in the diagnosis of infectious diseases.
4. Real-Time PCR: Identify the advantages of real-time PCR in the diagnosis of infectious diseases.
5. Reverse Transcriptase PCR (RT-PCR): Understand the principles and applications of RT-PCR in the diagnosis of infectious diseases.
6. Loop-Mediated Isothermal Amplification (LAMP): Identify the advantages of LAMP in the diagnosis of infectious diseases.
7. Next-Generation Sequencing (NGS): Understand the principles and applications of NGS in the diagnosis of infectious diseases.
8. Microarray Technology: Identify the principles and applications of microarray technology in the diagnosis of infectious diseases.
9. Multiplex PCR: Understand the principles and applications of multiplex PCR in the diagnosis of infectious diseases.
10. Digital PCR: Identify the advantages of digital PCR in the diagnosis of infectious diseases.
11. Hybridization-Based Techniques: Understand the principles and applications of hybridization-based techniques in the diagnosis of infectious diseases.
12. MALDI-TOF Mass Spectrometry: Identify the principles and applications of MALDI-TOF mass spectrometry in the diagnosis of infectious diseases.
13. Infectious Disease Diagnostics in Developing Countries: Identify the challenges and opportunities in the use of molecular diagnostics in developing countries.

14. Clinical Applications of Molecular Diagnostics: Identify the clinical applications of molecular diagnostics in infectious diseases.
15. Emerging Infectious Diseases: Understand the principles and applications of molecular diagnostics in emerging infectious diseases.
16. Pathogen Genomics: Understand the principles and applications of pathogen genomics in the diagnosis and management of infectious diseases. 22. Point-of-Care Testing: Understand the principles and applications of point-of-care testing in the diagnosis of infectious diseases.

Practical Classes and Objectives:

1. Nucleic Acid Extraction: To extract nucleic acid from different sample types using various extraction techniques.
2. PCR Optimization: To optimize PCR conditions and troubleshoot technical issues.
3. Real-Time PCR: To perform real-time PCR for the diagnosis of infectious diseases and analyze the results.
4. Next-Generation Sequencing: To perform next-generation sequencing and analyze the results for the diagnosis of infectious diseases.
5. Microarray Analysis: To perform microarray analysis and analyze the results for the diagnosis of infectious diseases.
6. Digital PCR: To perform digital PCR and analyze the results for the diagnosis of infectious diseases.
7. Hybridization-Based Techniques: To perform hybridization-based techniques and analyze the results for the diagnosis of infectious diseases.
8. Mass Spectrometry: To perform mass spectrometry and analyze the results for the diagnosis of infectious diseases.
9. Serology: To perform serological tests for the diagnosis of infectious diseases and analyze the results.
10. Sample Handling and Storage: To understand the principles and importance of sample handling and storage in molecular diagnostics of infectious diseases.
11. Point of Care Testing: To perform point of care testing for the diagnosis and management of infectious diseases.
12. Laboratory Management: To understand the principles and importance of laboratory management in the molecular diagnostics of infectious diseases.
13. Case Studies: To analyze and interpret case studies related to the molecular diagnostics of infectious diseases.

14. Antimicrobial Resistance: To understand the principles and applications of molecular diagnostics in the diagnosis and management of antimicrobial resistance.
15. Companion Diagnostics: To understand the principles and applications of companion diagnostics in the diagnosis and management of infectious diseases.
16. Future Perspectives: To understand the future perspectives and advances in molecular diagnostics of infectious diseases.

References:

1. Mackay IM, Arden KE, Nitsche A. Real-time PCR in virology. Nucleic acids research. 2002 Jul 1;30(6):1292-305.
2. Kaneko H, Kawana T, Fukushima E, Suzutani T. Tolerance of loop-mediated isothermal amplification to a culture medium and biological substances. Journal of bioscience and bioengineering. 2007 Apr 1;103(4):347-50.

6	Course title: Molecular Therapeutics	Course Code: MOLD-405

Overall Description and Aims:

The course is designed for students studying biomedical sciences who are interested in the discovery, development, and delivery of novel therapeutics at the molecular level. The course aims to provide students with a comprehensive understanding of the principles and practices of molecular therapeutics, including the use of genetic, molecular, and cellular approaches to drug development, the optimization of drug efficacy and safety, and the regulatory and ethical considerations of drug development.

Intended Learning Outcomes of the Course:

Knowledge and Understanding:

- Understand the principles of molecular biology and their relevance to medicine
- Understand the techniques involved in the development of molecular therapeutics
- Understand the different types of molecular targets for drug development
- Understand the role of genomics and proteomics in drug discovery

Intellectual Skills:

- Critically evaluate the scientific literature related to molecular therapeutics
- Design and develop molecular therapeutics based on scientific principles

Professional and Practical Skills:

- Apply molecular biology techniques in drug discovery and development
- Communicate scientific information effectively to both scientific and non-scientific audiences
- Understand the regulatory and ethical issues associated with the development and use of molecular therapeutics

General Transferable Skills:

- Critical thinking and problem-solving
- Effective communication
- Teamwork and collaboration
- Time management and organization

Course topics:

Introduction
Microbial diseases
Cancer and heart disease
Genetic diseases
Role of molecular biology in therapeutics
Simple protein replacement therapy
Preventing transfusion-transmissible infectious diseases in the UK
Ensuring the safety of organ transplants
Preventing transfusion-transmissible infectious diseases worldwide HIV

Recombinant protein production
Choice of organism
Alternatives to E coli for the production of recombinant proteins
Problems with recombinant protein production
Recombinant products

Recombinant vaccines
Vaccine history
Vaccines
Vaccine methods
Types of vaccine
The limitations of vaccine programmes
The role of the WHO
Problems specific to developing countries
Recombinant vaccines
Rational design: bioinformatics and proteomics

Therapeutic antibodies and immunotherapy
Monoclonal antibodies
Monoclonal production
Therapeutic monoclonal antibodies
Transgenic monoclonals
The uses of monoclonal antibodies in therapy
Specific examples of therapeutic strategies

Transgenic animals
Why do we want to engineer the genomes of animals?
Experimental procedure

DNA constructs, insertional mutagenesis and homologous recombination
Uses of inducible and tissue-specific promoters
Introduction of the DNA into the cells
Uses of transgenics

Transplantation: a form of gene therapy
Introduction
Bone marrow
Solid organ transplantation
Other cells and tissues

Reproductive cloning
History
Problems
Why was there so much interest in Dolly?
Why is cloning useful?
Is human cloning a reality?
Why can we not produce human clones that are identical?
So why clone humans?
What are the ethical and moral problems?

Stem cell therapy
The potency of cells
Cloning
Potency of stem cells
Potential sources of stem cells
Stem cells and therapeutic cloning
Other sources of stem cells
Experiments on embryonic cells
Experiments on fetal tissue and cord blood
Stem cells from adult tissues
Perceived scope of therapy
Clinical trials of stem cell therapy
What are the future prospects for stem cell research?

Gene augmentation therapy
Introduction
Strategy

Gene therapy trials for inherited diseases

Examples of disease treated with retroviral gene therapy
Cystic fibrosis
Animal trials with Factor IX
Adenoviruses have also been used to introduce genes into brain
Duchenne's muscular dystrophy
Problems with adenoviruses
The uses of adeno-associated viruses
Liposome vector trials
Trials with polymer mareix delivery

Gene silencing technologies
Antisense therapy
Triple helix (triplex) technology
Ribozymes
Small interfering RNAs (siRNAs)

Gene therapy for cancer
Cancer: a multifactorial disease
Best treatment currently available
Do chemo- and radiotherapy cause problems?
New cancer therapies
Cancer models in animals
What kinds of gene therapy can we use to treat cancer?
Perceived problems in cancer gene augmentation therapy
Gene silencing technologies and cancer

Single-nucleotide polymorphisms (SNPs) and therapy
Legislation, clinical trials and ethical issues

References:

1. Principles of Molecular Medicine, Second Edition by J. Larry Jameson, Joseph Loscalzo, Dennis Kasper, Stephen Hauser, Dan Longo
2. Molecular Medicine: An Introduction by Jens Kurreck, Tanja Weil, and Stefan Endres.
3. Greenwell, P., & McCulley, M. (2013). Molecular Therapeutics: 21st Century Medicine. Springer.

7	Course title: Seminar in Molecular Diagnostics	Course Code: MOLD-408

Overall description and aims:

The course aims to develop students' critical thinking and presentation skills in the context of molecular diagnostics. Through these seminars, students will have the opportunity to explore and present on a variety of topics related to the application of molecular diagnostic techniques in biomedical research and clinical practice. The seminars aim to promote critical thinking, effective communication, and research skills. The course will cover various topics related to the application of molecular diagnostics in clinical and research settings, including the principles of molecular biology, DNA sequencing, PCR, gene expression analysis, and next-generation sequencing. Overall, organizing and conducting a seminar by students is a great way to learn about new topics, share knowledge and ideas, and improve public speaking and presentation skills.

Intended Learning Outcomes:

Upon completion of this course, students will have acquired the following knowledge, skills, and abilities:

Knowledge and Understanding:

- Understand the principles of molecular biology and how they relate to disease diagnosis.
- Understand the basics of DNA sequencing, PCR, gene expression analysis, and next-generation sequencing.
- Understand the applications of molecular diagnostics in clinical and research settings.

Intellectual Skills:

- Critically analyze and evaluate molecular diagnostic data.
- Synthesize and interpret molecular diagnostic data to formulate a diagnosis.
- Develop critical thinking and problem-solving skills.

Professional and Practical Skills:

- Demonstrate proficiency in public speaking and presentation skills.
- Interpret laboratory results and communicate findings effectively.

- Develop skills in conducting literature reviews and presenting scientific information.

General Transferable Skills:

- Enhance written and oral communication skills.
- Develop teamwork and collaboration skills.
- Develop time management and organizational skills.

Suggested course topics:

1. Introduction to molecular diagnostics.
2. Principles of molecular biology.
3. DNA sequencing technologies and applications.
4. Polymerase chain reaction (PCR) techniques and applications.
5. Gene expression analysis.
6. Next-generation sequencing technologies and applications.
7. Microarray technology and applications.
8. Molecular diagnostics in cancer.
9. Molecular diagnostics in infectious diseases.
10. Molecular diagnostics in genetic disorders.
11. Quality control and assurance in molecular diagnostics.
12. Ethical considerations in molecular diagnostics.
13. Applications of molecular diagnostics in personalized medicine.
14. Trends and future directions in molecular diagnostics.
15. Oral and written presentation skills in molecular diagnostics.

How Seminar is performed:

A seminar performed by students is typically a presentation or discussion on a specific topic that is led by one or more students. Here are the typical steps for organizing and conducting a seminar by students:

1. Topic Selection: Choose a topic that is relevant and interesting to the audience. It is important to select a topic that is within the scope of the course or program of study.
2. Identify the Speakers: Identify one or more speakers who are knowledgeable and experienced in the chosen topic. Speakers can be fellow students, faculty members, or industry professionals.

3. Set a Date and Venue: Choose a date and a venue that is suitable for the seminar. The venue should be able to accommodate the number of participants and should have the necessary audio-visual equipment.
4. Promote the Seminar: Advertise the seminar through various channels such as social media, email, and flyers to attract attendees.
5. Seminar Preparation: The speakers should prepare their presentations or discussions ahead of time, making sure to cover all the important points of the topic. It is also important to practice the presentation to ensure a smooth delivery.
6. Conducting the Seminar: The seminar can be conducted in several formats, such as a lecture, a panel discussion, or a workshop. The speakers should present their topics and allow time for questions and discussions from the audience.
7. Evaluation: After the seminar, students are evaluated based on the quality of their research, the clarity and effectiveness of their presentation, their ability to engage with the

8	Course title: Thesis	Course Code: MOLD-409

Overall Description and Aims:

The undergraduate thesis is designed to provide students with an opportunity to undertake a research project in the field of molecular diagnostics. The course aims to develop the students' research skills, including experimental design, data analysis, and interpretation of results. The students will work closely with a supervisor who will guide them throughout the project. The course is also designed to promote critical thinking, problem-solving, and effective communication skills. Overall, performing a thesis in molecular diagnostics under supervision can provide valuable guidance and support throughout the research process, helping to ensure that the research is of high quality and contributes to the advancement of knowledge in the field.

Intended Learning Outcomes:

Upon completion of the course, students should be able to:

Knowledge and Understanding:

- Demonstrate an understanding of the principles and concepts of molecular diagnostics research
- Critically evaluate the relevant scientific literature in the field of molecular diagnostics
- Understand the ethical considerations involved in molecular diagnostics research

Intellectual Skills:

- Develop a research question and design an appropriate experimental approach
- Analyze and interpret data obtained from molecular diagnostics experiments
- Develop hypotheses and draw conclusions based on the results obtained

Professional and Practical Skills:

- Conduct molecular diagnostics experiments independently and accurately
- Demonstrate proficiency in laboratory techniques and skills relevant to the field of molecular diagnostics
- Plan, execute and manage a research project in molecular diagnostics

General Transferable Skills:

- Communicate scientific findings effectively in written and oral forms
- Work independently or in a team to achieve specific goals
- Demonstrate time management and organizational skills

Suggested Topics:

1. Molecular diagnostics assays and techniques
2. Design and optimization of molecular diagnostics assays
3. Evaluation of molecular diagnostic assay performance
4. Molecular diagnostics in cancer
5. Molecular diagnostics in infectious diseases
6. Molecular diagnostics in inherited diseases
7. Molecular diagnostics in pharmacogenomics
8. NGS and bioinformatics in molecular diagnostics
9. Validation of molecular diagnostic assays
10. Clinical applications of molecular diagnostics
11. Future trends and challenges in molecular diagnostics

Assessment Methods:

The thesis in molecular diagnostics will be assessed using a variety of methods, including:

1. Thesis Evaluation: to evaluate the students' research design, data analysis, and interpretation of results
2. Oral presentations to assess the students' ability to communicate scientific information effectively

How thesis is performed in molecular diagnostics:

The thesis is a self-directed research project, and the specific topic will be determined by the student in consultation with a supervisor. Performing a thesis in molecular diagnostics involves working closely with an advisor or supervisor throughout the entire research process. Here are the typical steps for performing a thesis in molecular diagnostics:

1. Topic Selection: Work with your supervisor to select a research topic that is relevant to the field of molecular diagnostics and that is of interest to you.
2. Literature Review: Conduct a thorough literature review with guidance from your supervisor to gain an understanding of the current state of knowledge on the topic. This will help you identify gaps in the literature that your research can address.
3. Research Design: Work with your supervisor to develop a research design that will address the research question or hypothesis. Your supervisor can help you select appropriate research methods, such as polymerase chain reaction (PCR) or next-generation sequencing (NGS), and determine the sample size and data analysis techniques.
4. Data Collection: Collect data with guidance from your supervisor using the research methods identified in the research design. Your supervisor can provide guidance on collecting biological samples, such as blood or tissue samples, or conducting experiments in the laboratory.
5. Data Analysis: Analyze the data with guidance from your supervisor using appropriate statistical methods. Your supervisor can help you determine whether your research hypothesis has been supported or not.
6. Results and Discussion: Work with your supervisor to present your findings in a clear and concise manner, and discuss the implications of your research in the context of the current state of knowledge.
7. Conclusion and Recommendations: Summarize your findings with guidance from your supervisor and provide recommendations for future research in the field of molecular diagnostics.
8. Thesis Defense: Work with your supervisor to prepare for your thesis defense in front of a thesis committee, which will typically include faculty members and experts in the field of molecular diagnostics.

9	Course title: Workplace Experience	Course Code: MOLD-410

Course Description:

This course provides undergraduate students with the knowledge and practical skills required for molecular diagnostics in pathology and medical laboratory settings. The course covers various molecular techniques and methods used for diagnosing diseases and monitoring treatment outcomes.

Overall Aims of Course:

- Provide students with a comprehensive understanding of the principles and applications of molecular diagnostics in pathology and medical laboratory settings.
- Equip students with the practical skills necessary to perform molecular diagnostic tests and interpret results accurately.
- Develop students' critical thinking, analytical, and problem-solving skills in the context of molecular diagnostics.
- Foster professional and ethical conduct among students in the laboratory setting.
- Cultivate general transferable skills such as communication, teamwork, and time management.

Intended Learning Outcomes of Course: By the end of the course, students should be able to:

- Demonstrate an understanding of the principles and applications of various molecular techniques used in pathology and medical laboratory settings.
- Apply their knowledge to perform molecular diagnostic tests and interpret results accurately.
- Analyze and interpret data obtained from molecular diagnostic tests.
- Evaluate the advantages and limitations of different molecular diagnostic techniques.
- Demonstrate professional and ethical conduct in the laboratory setting.
- Communicate effectively with colleagues and patients in the context of molecular diagnostics.
- Collaborate with others in a team to accomplish tasks effectively.
- Manage their time efficiently in a laboratory setting.

Intellectual Skills:

- Analyzing data obtained from molecular diagnostic tests.
- Evaluating the advantages and limitations of different molecular diagnostic techniques.
- Applying knowledge of molecular biology to perform and interpret molecular diagnostic tests accurately.
- Developing hypotheses and designing experiments to test them.

Professional and Practical Skills:

- Performing various molecular diagnostic tests, such as PCR, sequencing, and microarray.
- Maintaining laboratory safety and hygiene.
- Following laboratory protocols and procedures.
- Recording and analyzing data obtained from molecular diagnostic tests.
- Communicating effectively with colleagues and patients.
- Demonstrating professional and ethical conduct in the laboratory setting.

General Transferable Skills:

- Communicating effectively with others.
- Working collaboratively in a team.
- Managing time effectively.
- Analyzing and interpreting data.
- Developing critical thinking and problem-solving skills.

Suggested Training Schedule (10 hours per week for 24 weeks):

Week 1-2: Introduction to Molecular Diagnostics (20 hours)

- Introduction to molecular biology and genetics.
- Overview of molecular diagnostic techniques.
- Laboratory safety and hygiene.
- PCR and real-time PCR.

Week 3-4: DNA Extraction and Purification (20 hours)

- Principles of DNA extraction and purification.
- Different extraction methods and their advantages and limitations.
- Quality control of extracted DNA.
- Troubleshooting and optimization of DNA extraction protocols.

Week 5-6: DNA Sequencing (20 hours)

- Introduction to DNA sequencing.
- Different types of sequencing methods.
- Sample preparation and purification for sequencing.
- Data analysis and interpretation.

Week 7-8: Microarray (20 hours)

- Introduction to microarray technology.
- Sample preparation and labeling for microarray analysis.
- Hybridization and scanning.
- Data analysis and interpretation.

Week 9-10: Next-Generation Sequencing (20 hours)

- Introduction to next-generation sequencing.
- Library preparation and sequencing.
- Data analysis and interpretation.
- Comparison with other sequencing methods.

Week 11-12: Real-time PCR and Applications (20 hours)

- Principles of real-time PCR.
- Sample preparation and optimization for real-time PCR.
- Data analysis and interpretation.
- Applications of real-time PCR in molecular diagnostics.

Week 13-14: Immunodiagnostics and Applications (20 hours)

- Introduction to immunodiagnostics.
- Different types of immunoassays and their applications.
- Sample preparation and optimization for immunoassays.
- Data analysis and interpretation.

Week 15-16: Quality Control and Quality Assurance (20 hours)

- Introduction to quality control and quality assurance in molecular diagnostics.
- Different quality control methods and their applications.
- Implementation of quality control in the laboratory.
- Troubleshooting and optimization of quality control methods.

Week 17-18: Infectious Disease Diagnostics (20 hours)

- Introduction to infectious disease diagnostics.
- Different types of molecular diagnostic methods for infectious diseases.
- Sample preparation and optimization for infectious disease diagnostics.
- Data analysis and interpretation.

Week 19-20: Cancer Diagnostics (20 hours)

- Introduction to cancer diagnostics.
- Different types of molecular diagnostic methods for cancer.
- Sample preparation and optimization for cancer diagnostics.
- Data analysis and interpretation.

Week 21-24: Integration and Assessment (40 hours)

- Integration of all molecular diagnostic techniques covered in the course.
- Practical assignments and exams to test students' knowledge and practical skills.
- Feedback and evaluation of students' performance in the course.
- Final project and presentation designed to apply knowledge and skills in a real-world context.

Method of assessment

The following are some methods of assessment that could be used for the Workplace Experience :

1. Practical assessments: Students can be assessed on their ability to perform laboratory procedures, identify cells and tissues, and interpret laboratory results.
2. Written assignments: Assignments such as essays, case studies, or laboratory reports can be used to assess students' understanding of the course content and their ability to apply it in practice.
3. Presentations: Students can be asked to deliver presentations on a particular topic related to the course. This will help to assess their research and communication skills.
4. Examinations: A formal examination can be conducted at the end of the course to assess the students' knowledge and understanding of the course content.

5. Laboratory journal: Students can be asked to keep a journal of their laboratory work, including their observations, analysis, and conclusions. This will help to assess their practical skills, as well as their ability to record and analyze data.
6. Peer review: Students can be asked to review each other's work, such as laboratory reports or presentations. This will help to develop their critical thinking and analysis skills.
7. Feedback and reflection: Throughout the course, students can be encouraged to reflect on their learning and provide feedback on the course content and teaching methods. This will help to assess the effectiveness of the course and identify areas for improvement.

FORMS

University of Benghazi

Faculty of Biomedical Sciences
Department of Molecular Diagnostics

Student Seminar Evaluation Form

Academic year: 20___/20___

Evaluator's Name:			Credentials:	❒ MSc	❒ PhD
Evaluator's phone #:	09	Email:			
Student's Name			Student ID:		
Seminar Title:					
Location:		Date:	D	M	Y

Instructions: Please rate the student's performance in each category below:

Presentation Skills (25%)

- Did the presenter maintain eye contact with the audience? ____/5
- Was the presenter's voice clear and audible? ____/5
- Did the presenter use appropriate language and terminology? ____/5
- Did the presenter engage the audience effectively? ____/5

Overall score: [ ]

Content (25%)

- Did the presenter demonstrate a clear understanding of the topic? ____/5
- Was the information presented accurate and up-to-date? ____/5
- Did the presenter provide sufficient depth of understanding? ____/5
- Did the presenter effectively apply relevant concepts? ____/5

Overall score: [ ]

Critical Thinking (15%)

- Did the presenter demonstrate critical thinking skills in analyzing the information? ___/5
- Did the presenter make connections to related topics? ____/5
- Did the presenter offer unique insights or perspectives? ____/5

Overall score: [ ]

Organization and Clarity (15%)

- Was the presentation well-organized and logically sequenced? ____/5
- Were the explanations clear and easy to understand? ____/5
- Did the presenter effectively use visual aids? ____/5

Overall score: [ ]

Time Management (10%)

- Did the presenter complete the presentation within the allotted time frame? __/7.5
- Did the presenter effectively pace the presentation? ____/7.5

Overall score: [ ]

Student Seminar Evaluation Form

Question and Answer Session (10%)
Did the presenter effectively respond to questions from the audience? ____/7.5
Did the presenter demonstrate depth and accuracy in their answers? ____/7.5
Overall Evaluation:
How effective was the presentation overall? [ ] Very effective [ ] Somewhat effective [ ] Not effective
What were the strengths of the presentation?
What were the areas that need improvement?

Overall Score: (Out of 100) _____
Comments: (optional):

Evaluator's Signature:		**Date:**	D	M	Y

Department Head Signature:		**Date:**	D	M	Y

University of Benghazi
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Department of Molecular Diagnostics

خاص بالقسم:
موافقة ❒
رفض ❒

نموذج تسجيل مقترح مشروع تخرج _____20/_____20

فردي ❒	جماعي ❒	

بيانات الطالب

ر.م	الاسم	الرقم الدراسي	رقم الهاتف	التوقيع
1				
2				
3				
4				
5				

بيانات المشرف

الاسم	الجهة التي يعمل بها	رقم الهاتف	المؤهل العلمي	
			❒ ماجستير	❒ دكتوراة

البريد الالكتروني:	
عنوان المشروع:	
.....	
.....	
كلمات مفتاحية:	

ملاحظة:

- **كل طالب مسجل بالسنة الدراسية الرابعة مطالب بتقديم أطروحة لبحث مكتوبة بطريقة علمية وأكاديمية بالإضافة الى تقديم عرض تقديمي خاص بالبحث لغرض مناقشة المشروع وتقييمه.**
- **يجب على كل طالب تعبئة هذا النموذج متضمنا توقيعه والمشرف الخاص به ومن ثم يسلم الى منسق المشاريع بالقسم.**
- **يجب ان يكون المشرف متحصلا على درجة علمية (ماجستير او دكتوراه).**
- **في حالة المشاريع الفردية (عنوان البحث خاص بطالب واحد فقط) يجب على الطالب ان ينجز كتابة كامل الاطروحة. اما في حالة العمل كفريق فكل طالب ملزم ان يشارك بشكل متساوي في انجاز الاطروحة.**
- **يجب على كل مشرف تعبئة نموذج التقرير الشهري لأداء تقييم كل طالب ونسبة ما تم إنجازه بمشروع التخرج وإرساله الى القسم المختص (سيتم تزويد المشرف بعنوان البريد الالكتروني لاحقا).**

الصفة	التوقيع	التاريخ		
		ي	ش	س
المشرف				
منسق المشاريع بالقسم				
اعتماد رئيس القسم				

University of Benghazi
Faculty of Biomedical Sciences
Department of Molecular Diagnostics

Undergraduate Thesis Student Progress Form

Academic year: 20____/20____

Meeting number ( )

Thesis Supervisor:		Credentials:	❒ MSc	❒ PhD
Student Name		Student ID:		
Thesis Title:				

Progress Overview:

Please provide a brief summary of the progress you have made since the last progress meeting

Tasks Completed:

1	Data Collection	❒ Yes	❒ No ▸	
2	Statistical Analysis	❒ Yes	❒ No ▸	
3	Writing: Abstract	❒ Yes	❒ No ▸	
4	Writing: Introduction	❒ Yes	❒ No ▸	
5	Writing: Literature Review	❒ Yes	❒ No ▸	
6	Writing: Methodology	❒ Yes	❒ No ▸	
7	Writing: Results	❒ Yes	❒ No ▸	
8	Writing: Discussion	❒ Yes	❒ No ▸	
9	Writing: Conclusion	❒ Yes	❒ No ▸	
10	Editing and Revision	❒ Yes	❒ No ▸	

Tasks in Progress: List any tasks that you are currently working on**.**

Challenges: List any challenges or obstacles that you have encountered since the last progress meeting, eg: Difficulty obtaining data from some sources or Issues with statistical software

Undergraduate Thesis Student Progress Form

Upcoming Deadlines: List any upcoming deadlines that you need to meet.
Deadline for submission of first draft: _____/_____/20___
Deadline for submission of final draft: _____/_____/20___

Thesis Supervisor Comments:
Student Comments:

Thesis Supervisor Signature:		**Date:**	D	M	Y

Student Signature:		**Date:**	D	M	Y

Department Head Signature:		**Date:**	D	M	Y

University of Benghazi

Faculty of Biomedical Sciences
Department of Molecular Diagnostics

Thesis Defense Evaluation Form

Academic year: 20___/20___

Evaluator's Name:			Credentials:	❒ MSc	❒ PhD
Evaluator's phone #:	09	Email:			
Student's Name		Student ID:			
Thesis Title:					
Location:		Date:	D	M	Y

Instructions: Please rate the student's performance in each category below:

❒ Poor (0-59%)	❒ Fair (60-69%)	❒ Good (70-89%)	❒ Excellent (90-100%)

Presentation (10%)

- Did the student maintain eye contact with the audience? ____/2.5
- Was the student's voice clear and audible? ____/2.5
- Did the student use appropriate language and terminology? ____/2.5
- Did the student engage the audience effectively? ____/2.5

Overall score: [ ]

Content (40%)

- Did the student provide a clear and concise statement of the research problem or question? ____/8
- Were the research methods appropriate and well-described? ____/8
- Did the student provide a thorough and accurate literature review? ____/8
- Were the results presented clearly and accurately? ____/8
- Were the conclusions supported by the data? ____/8

Overall score: [ ]

Critical Thinking and Analysis (30%)

- Did the student demonstrate a critical analysis of the research problem? ____/7.5
- Did the student show an understanding of the broader context of the research? ____/7.5
- Did the student present a unique contribution to the field of study? ____/7.5
  ❒ Yes ❒ No
- Did the student provide a well-supported argument? ____/7.5
- Did the student demonstrate a critical analysis of the research problem? ____/7.5

Overall score: [ ]

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Department of Molecular Diagnostics

Thesis Defense Evaluation Form

Defense and Response (20%)
Did the student respond effectively to questions from the audience? ____/5
Did the student demonstrate a clear understanding of the research problem, methods, results, and conclusions? ____/5
Did the student show a willingness to engage in critical dialogue? ____/5
Overall score: [ ]
Overall Evaluation: [10%]
How effective was the thesis defense overall? ____/5 [ ] Very effective [ ] Somewhat effective [ ] Not effective
What were the strengths of the defense? ____/2.5
What were the areas that need improvement? ____/2.5
Overall score: [ ]

Overall Score: (Out of 100) _____
Comments: (optional):

Evaluator's Signature:		**Date:**	D	M	Y

Department Head Signature:		**Date:**	D	M	Y

University of Benghazi
Faculty of Biomedical Sciences
Department of Molecular Diagnostics

Thesis Evaluation Form

Academic year: 20____/20____

Evaluator's Name:			Credentials:	❒ MSc	❒ PhD
Evaluator's phone #:	09	Email:			
Student's Name		Student ID:			
Thesis Title:					

Instructions: Please rate the student's performance in each category below:			
❒ Poor (0-59%)	❒ Fair (60-69%)	❒ Good (70-89%)	❒ Excellent (90-100%)

Thesis Content (40%)
Does the thesis provide a clear and concise statement of the research problem or question? ___ /10
Are the research methods appropriate and well-described? ___ /10
Does the thesis provide a thorough and accurate literature review? ___ /10
Are the results presented clearly and accurately? ___ /10
Are the conclusions supported by the data? ___ /10
Overall score: [ ]
Critical Thinking and Analysis (30%)
Does the thesis demonstrate a critical analysis of the research problem? ___/7.5
Does the thesis show an understanding of the broader context of the research? ___/7.5
Does the thesis present a unique contribution to the field of study? ___/7.5
Does the thesis provide a well-supported argument? ___/7.5
Overall score: [ ]

Writing Style and Clarity (20%)
Is the writing clear and well-organized? ___/5
Does the thesis follow appropriate grammar and syntax rules? ___/5
Is the language appropriate for the academic audience? ___/5
Does the thesis use appropriate formatting and citation style? ___/5
Overall score: [ ]

University of Benghazi
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Department of Molecular Diagnostics

Thesis Evaluation Form

Overall Evaluation: [10%]
How effective is the thesis in communicating the research problem, methods, results, and conclusions? ___/5 [ ] Very effective [ ] Somewhat effective [ ] Not effective
What were the strengths of the thesis? ___/2.5
What were the areas that need improvement? ___/2.5
Overall score: [ ]

Overall Score: (Out of 100) _____
Comments: (optional):

Evaluator's Signature:		**Date:**	D	M	Y

Department Head Signature:		**Date:**	D	M	Y

University of Benghazi
Faculty of Biomedical Sciences
Department of Molecular Diagnostics

Student Performance Evaluation Form for Workplace Experience

Academic year: 20____/20____

Training Location:		Date:	D	M	Y
Instructor Name:		Credentials:	❒ BSc	❒ MSc	❒ PhD
Instructor phone #:	09	Email:			
Student Name		Student ID:			

Instructions: Please rate the student's performance in each category below by selecting the appropriate response.

❒ Poor (0-59%)	❒ Fair (60-69%)	❒ Good (70-89%)	❒ Excellent (90-100%)

Category 1: Attendance and Participation (20%)	
	Attended classes regularly and on time: [ ]
	Actively participated in discussions and group activities: [ ]
	Engaged in self-directed learning and demonstrated a desire to learn: [ ]
	Overall score: [ ]
Category 2: Knowledge and Understanding (30%)	
	Demonstrated understanding of concepts and theories presented in class: [ ]
	Applied knowledge to complete assignments and exams: [ ]
	Showed evidence of critical thinking and problem-solving skills: [ ]
	Overall score: [ ]
Category 3: Technical Skills (30%)	
	Demonstrated competency in technical skills: [ ]
	Properly used laboratory equipment and followed safety protocols: [ ]
	Completed laboratory work with accuracy and precision: [ ]
Category 4: Professionalism (20%)	
	Demonstrated professional behavior and attitude towards classmates and instructor: [ ]
	Communicated effectively and respectfully with classmates and instructor: [ ]
	Showed initiative in completing assignments and participating in group work: [ ]
	Overall score: [ ]
Overall performance in the program: [ ]	
Additional Comments:	

Instructor Signature:		**Date:**	D	M	Y
Department Head Signature:		**Date:**	D	M	Y

University of Benghazi

Faculty of Biomedical Sciences
Department of Molecular Diagnostics

Evaluation Form for Undergraduate Course

Academic year: 20____/20____

Dear Student,

Please take a few minutes to complete the following evaluation form. Your feedback is important to us as we strive to continuously improve the quality of our courses.

Course Title:	**Course Code:**

1	**How would you rate the overall quality of the course?**				
	❒ Poor	❒ Fair	❒ Good	❒ Very Good	❒Excellent
2	**How well did the course meet your expectations?**				
	❒ Not at all	❒ Somewhat	❒ Neutral	❒ Very well	❒ Extremely well
3	**Which topics in the course did you find most interesting?**				
4	**Which topics in the course did you find least interesting?**				
5	**Were the course materials (syllabus, textbook, readings, etc.) clear and easy to understand?**				
	❒ Strongly Disagree	❒ Disagree	❒ Neutral	❒ Agree	❒ Strongly Agree
6	**Was the pace of the course appropriate?**				
	❒ Too slow	❒ Somewhat slow	❒ Appropriate	❒Somewhat fast	❒ Too fast
7	**Was the course well-structured and organized?**				
	❒ Poorly structured & organized	❒ Somewhat poorly structured & organized	❒ Neutral	❒ Well-structured & organized	❒ Extremely well-structured & organized
8	**Did you feel that the instructor was knowledgeable and engaging?**				
	❒ Strongly Disagree	❒ Disagree	❒ Neutral	❒ Agree	❒ Strongly Agree
9	**Were the assignments and exams helpful in reinforcing your knowledge and skills?**				
	❒ Not at all helpful	❒Somewhat helpful	❒ Neutral	❒ Very helpful	❒ Extremely helpful
10	**How would you rate the feedback and support provided by the instructor?**				
	❒ Poor	❒ Fair	❒ Good	❒ Very Good	❒Excellent
11	**What suggestions do you have for improving the course in the future?**				
	Thank you for your participation and feedback.				

University of Benghazi

Faculty of Biomedical Sciences
Department of Molecular Diagnostics

Evaluation Form for Workplace Experience

Academic year: 20___/20___

Dear Student,

Please take a few minutes to complete the following evaluation form. Your feedback is important to us as we strive to continuously improve the quality of our training programs.

Course Title:	**Course Code:**

1	**How would you rate the overall quality of the training program ?**				
	❒ Poor	❒ Fair	❒ Good	❒ Very Good	❒Excellent
2	**How well did the program meet your expectations?**				
	❒ Not at all	❒ Somewhat	❒ Neutral	❒ Very well	❒ Extremely well
3	**Which topics in the program did you find most interesting?**				
4	**Which topics in the program did you find least interesting?**				
5	**Were the course materials (handouts, presentation, practical, etc.) clear and easy to understand?**				
	❒ Strongly Disagree	❒ Disagree	❒ Neutral	❒ Agree	❒ Strongly Agree
6	**Was the pace of the program appropriate?**				
	❒ Too slow	❒ Somewhat slow	❒ Appropriate	❒Somewhat fast	❒ Too fast
7	**Was the program well-structured and organized?**				
	❒ Poorly structured & organized	❒ Somewhat poorly structured & organized	❒ Neutral	❒ Well-structured & organized	❒ Extremely well-structured & organized
8	**Did you feel that the instructor was knowledgeable and engaging?**				
	❒ Strongly Disagree	❒ Disagree	❒ Neutral	❒ Agree	❒ Strongly Agree
9	**Were the practical assignments helpful in reinforcing your knowledge and skills?**				
	❒ Not at all helpful	❒Somewhat helpful	❒ Neutral	❒ Very helpful	❒ Extremely helpful
10	**How would you rate the facilities and equipment provided for the program?**				
	❒ Poor	❒ Fair	❒ Good	❒ Very Good	❒Excellent
11	**What suggestions do you have for improving the program in the future?**				
	Thank you for your participation and feedback.				

Print title her

Academic year: 20____/20____