Course Syllabus

1	**Course title**	Molecular Biology
2	**Course number**	0308321
3	**Credit hours**	3 hrs
	Contact hours (theory, practical)	(2 theory +3 practical)/ week
4	**Prerequisites/corequisites**	General Microbiology
5	**Program title**	Clinical Laboratory Sciences
6	**Program code**	0308
7	**Awarding institution**	The University of Jordan
8	**School**	School of Science
9	**Department**	Department of Clinical Laboratory Sciences
10	**Course level**	Junior level
11	**Year of study and semester (s)**	Second Semester (2023/2024)
12	**Other department (s) involved in teaching the course**	None
13	**Main teaching language**	English
14	**Delivery method**	☐√ Face to face learning ☐Blended ☐Fully online
15	**Online platforms(s)**	☐Moodle ☐√ Microsoft Teams ☐Skype ☐Zoom ☐√Others…Class room……
16	**Issuing/Revision Date**	Feb 2024

17 Course Coordinator:

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18 Other instructors:

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19 Course Description:

This course begins by considering the chemical nature of nucleic acids, physical chemistry of nucleic acids, chromatin structure, molecular structure of genes, organization of genes on the prokayotic and eukaryotic genomes, and the complexity of the eukaryotic genome. This is followed by DNA replication, repair, gene expression, regulation of gene expression in prokaryotes and eukaryotes, and nuclear and cytoplasmic mechanisms of post-transcriptional control. Recombinant DNA technology, genomics, bioinformatics and analysis of gene structure and expression are covered in brief. The laboratory covers the following topics in the recombinant DNA technology with their applications: isolation of nucleic acids, quantitation and qualification of nucleic acids, DNA amplification by polymerase chain reaction, Southern blot, plasmid isolation, plasmid restriction mapping, gene expression and gene knock out, DNA-cloning, protein purification, and bioinformatics.

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20 Course aims and outcomes:

A- **Aims:**

This course aims at introducing the student to the basic concepts of molecular biology including the molecular nature of genes, chromatin structure, DNA replication, repair, gene expression and regulation of gene expression, recombinant DNA technology, genomics and bioinformatics.

B- **Students Learning Outcomes (SLOs):**

For purposes of mapping the course SLOs to the CLS program SLOs, at the successful completion of the Clinical Laboratory Sciences program, graduates are expected to be able to:

SLO(1). Understand and apply the theoretical foundations of medical laboratory sciences to accurately calibrate and operate advanced laboratory equipment.

SLO(2). Demonstrate knowledge of safety protocols, Ministry of Health regulations, and environmental preservation practices when handling samples of pathogens and chemical/biological risks.

SOL(3). Acquire in-depth technical knowledge to stay abreast of scientific advancements and actively participate in local and global applied research in the field.

SOL(4). Perform diverse analyses and effectively interpret results for various clinical samples across laboratory disciplines such as hematology, clinical chemistry, microbiology, urine analysis, body fluids, molecular diagnostics, and immunology.

SOL(5). Apply practical training to solve complex problems, troubleshoot issues, and interpret results, ensuring a connection between data and specific medical conditions for precise diagnosis.

SOL(6). Show effective communication skills to convey information accurately and appropriately in a laboratory setting.

SOL(7). Demonstrate a commitment to lifelong learning and innovation by applying modern techniques, critically analyzing information, and contributing to the creation and application of new knowledge in medical laboratory sciences which fulfil the requirements of national and international CBD.

SOL(8). Uphold professional ethical behavior, ensuring the confidentiality of client information, and respecting client privacy throughout all aspects of laboratory work.

SOL(9). Apply managerial skills that align with quality assurance, accreditation, quality improvement, laboratory education, and resource management, showcasing competence in the effective administration of laboratory practices.

Descriptors	ILO/ID	Program SLOs / Course SLOs	SLO (1)	SLO (4)	SLO (5)
Knowledge	A1	Deduction of nucleic acid Structure	X		
	A2	Correlation of the nucleic acid structure to function	X		
	A3	Knowledge of the protein-nucleic acid interaction and its practical applications			X
Skills	B1	Understanding and differentiating the prokaryotic and eukaryotic gene structures	X		
	B2	Prediction of mutation consequences			X
Competence	C1	Knowledge of gene expression, regulation, and silencing	X		
	C2	Practical laboratory skills		X	
	C3	Bioinformatics tools usage			X

21. Topic Outline and Schedule:

Week	Lecture	Topic	Student Learning Outcome	Learning Methods (Face to Face/Blended/ Fully Online)	Platform	Synchronous / Asynchronous Lecturing	Evaluation Methods	Resources
1	1.1	**The nature of genetic material** The chemical nature of polynucleotides	1	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 1& 2
	1.2	The DNA structure, double helix and A,B, Z-forms (**assignment**) DNAs of various sizes and shapes RNA secondary and tertiary structures	1	Face to Face	Class Room	Synchronous	Exam, assignment, and oral Quiz	References 1& 2
2	2.1	Physical chemistry of nucleic acids. Organell DNA (**assignment**)	1	Face to Face	Class Room	Synchronous	Exam, assignment, and oral Quiz	References 1& 2
	2.2	**Chromatin structure** Histones Nucleosomes The 30-nm Fiber	1, 2, 3	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 1& 2
3	3.1	Higher-Order Chromatin Folding Euchromatin and heterochromatin	1, 2, 3	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 1& 2
	3.2	**Molecular structure of genes** Molecular definition of a gene Organization of genes in prokaryotic and eukaryotic genomes Bacterial operons and the production of polycistronic mRNAs	4	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2

		Eukaryotic genes and the production of monocistronic mRNAs						
4	4.1	Simple and complex transcription units in eukaryotic genome Exon skipping and alternative use of poly A sites and alternative use of promoters in the complex transcription units. Alternative RNA splicing increase the number of proteins expressed from a single eukaryotic gene.	4	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2
	4.2	**The complexity of the eukaryotic genome** Chromosomal organization of genes and noncoding sequences Protein-coding genes: solitary genes, duplicated and gene families, tandemly repeated genes.	1, 2	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2
5	5.1	Repitious DNA: Simple sequences: satellite, minisatellite, microsatellite. DNA fingerprinting	1, 2	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2
	5.2	Moderately repeated DNA sequences: Mobile DNA in prokaryotes and eukaryotes: transposons, viral and nonviral retrotransposons (LINES and SINES).	1, 2	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2
6	6.1	Mechanisms of transpositions. Processed pseudogenes Unclassified spacer DNA.	1, 2	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2
	6.2	**DNA replication (assignment)** General features of DNA replication (Semidiscontinuous and Bidirectional) Priming of DNA Synthesis Enzymology of DNA Replication Detailed Mechanism (Initiation, Elongation and Termination)	3	Online	Microsoft teams	Asynchronous	Exam, and oral Quiz	References 1& 2
7	7.1	**DNA damage and repair** Nucleotide excision repair. Base excision repair.	3, 5	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 1
	7.2	Double strand breakage repair. Mismatch repair.	3, 5	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 1
8	8.1	**Transcription** RNA polymerase structure in prokaryotes and eukaryotes.	3, 6	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2

		Transcription initiation by RNA polymerase I, II, III and organell-specific RNA polymerases.						
	8.2	Regulatory sequences in prokaryotes and eukaryotes. Activators, repressors and general transcription factors	3, 6	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2
9	9.1	Molecular mechanisms of transcription activation and repression: Modulation of chromatin structure	3, 6	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2
	9.2	Gene expression silencing Histone deacetylation and hyperacetylation Mediators Activators and co-activators control. Assembly of the preinitiation complex.	3, 6	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2
10	10.1	Stages of transcription in prokaryotes and eukaryotes: Initiation, Elongation and Termination. *in vivo* transfection technique	3, 6	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2
	10.2	Hormone-dependent gene expression	3, 6	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2
11	11.1	**Nuclear mechanisms of post-transcriptional control** Pre-mRNA processing: Splicing	1,3, 6	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2
	11.2	Capping, Cleavage/Polyadenylation.	1-3, 6	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2
12	12.1	Pre-rRNA processing: Splicing Cleavage Exonucleolytic digestion Base modification	1,2, 3	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2
	12.2	Pre-tRNA processing: Splicing Cleavage Base modification	1,3, 6	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2
13	13.1	**Cytoplasmic mechanisms of post-transcriptional control** Mechanisms of Mrna degradation in the Cytoplasm Surveillance mechanisms prevent translation of improperly processed mRNAs Localization of mRNAs permits production of proteins at specific regions within the cytoplasm	1,3, 6	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2

	13.2	Micro RNAs (miRNAs) RNA interference (RNAi)	1,3, 6	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2
14	14.1	**Translation** The genetic code **(assignment)** The structure of: t-RNA (**assignment**) Prokaryotic and eukaryotic ribosomes Aminoacylation of tRNA (**assignment**) Stages of translation in prokaryotes and eukaryotes (initiation, elongation and termination) Post-translational modifications.	6, 8	Face to Face	Class Room	Synchronous	Exam, assignment, and oral Quiz	References 2
	14.2	**Genomics and Bioinformatics** Analysis of gene structure and expression Sequence homology Query sequence Gene/protein identification Evolutionary relationships among proteins Evaluation of expression of many genes at one time and coregulated genes.	8	Face to Face	Class Room	Synchronous	Exam, assignment, and oral Quiz	References 2
15	15.1	**Recombinant DNA technology.** DNA extraction, restriction endonucleases, restriction map, PCR, Southern blot, DNA sequencing, vectors, cloning of genes, gene-knock out.	7	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2
	15.2	Microarray, genomic library and cDNA library.	7	Face to Face	Class Room	Synchronous	Exam, and oral Quiz	References 2

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22 Evaluation Methods:

Opportunities to demonstrate achievement of the SLOs are provided through the following assessment methods and requirements:

Evaluation Activity	Mark	Topic(s)	SLOs	Period (Week)	Platform
Assignments	5%	A,B, Z-forms of DNA, DNA replication, The genetic code, The structure of t-RNA, Aminoacylation of tRNA), and bioinformatics	1, 6, 8	WeeK 6	Class room
Quizzes	5%	• Recombinant DNA (Laboratory experiments) • oral quiz of theory (Bonus)	7 1-8	Week 3, 9, 10 Weekly	Laboratory Class room
Lab Reports	10%	Recombinant DNA (Laboratory experiments)	7	Weekly	Laboratory
First Exam	------	------	------	-------	------
Mid-term Exam	30%	Weeks 1-5 + 7	1-5	Week 10	Class room
Final Exam	50%	Weeks 1-5 + 7-15	1-7	Week 16	Class room

23 Course Requirements

(e.g: students should have a computer, internet connection, webcam, account on a specific software/platform…etc):

Internet connection, Text book, and References

24 Course Policies:

A- Attendance policies:

- Attend and participate in all classes: attendance will be taken.

Class time will be used to discuss, elaborate, expand, etc., on the written modules. This may include formal/informal lectures, audio visual presentations, demonstrations, labs, etc.

B- Absences from exams and handing in assignments on time:

1. A student who has been absent for 15% or more of the total hours of any course, including absences for medical or compassionate reasons, may be required to withdraw from that particular course.
2. Students who miss quizzes or examinations will automatically be assigned a mark of zero unless the respective instructor, or the Program Head, has been notified of the reason for absence *PRIOR* to the commencement of the exam. Acceptable reasons will be evaluated at the time (e.g., illness - medical certificate may be required, serious illness or death in the family, etc.). Supplemental examinations may be allowed in legitimate cases.

C- Health and safety procedures:

All students need to be immunized against hepatitis B, immunization certificate must be forwarded to the coordinator of the hospital training. Pregnancy affects immunization and it is the responsibility of the student to notify the health person as soon as possible of her pregnancy. If there are fees related to immunization, it is the responsibility of the student.

D- Honesty policy regarding cheating, plagiarism, misbehavior:

E- Grading policy:

Evaluation	Point %	Date
Assignments	5%	Tuesday 2/ 4 / 2024
Midterm Exam	30%	Tuesday 7/ 5 / 2024
Lab. Quizzes	10%	Will be announced in due time
Lab. Reports	5%	Will be announced in due time.
Final Exam including the laboratory (15%)	50%	Will be announced in due time.

F- Available university services that support achievement in the course:

1. Molecular Biology Laboratory.
2. The University Computer Laboratory.
3. The University Main Library.
4. The University e-library.

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25 References:

A- Required book(s), assigned reading and audio-visuals:

1. Molecular Biology, by R.F.Weaver, fifth edition, 2012, McGraw Hill Publisher.
2. Molecular Cell Biology, by H. Lodish, A. Berk, S.L. Zipursky, P. Matsudaira, D. Baltimore, J. Darnell, fifth edition, 2004, W. H. Freeman and Company.

B- Recommended books, materials, and media:

Recommend animation and videos on topics. Students are provided with the link of didoes in the practical part of this course

26 Additional information:

For more details on University regulations please visit: http://www.ju.edu.jo/rules/index.htm

Name of Course Coordinator: **Prof. Salwa Bdour** Signature: *Salwa Bdour* Date: 25/2/2024

Head of Curriculum Committee/Department: **Dr. Suzan Mattar** Signature: *Suzan Mattar*

Head of Department: **Dr. Ahmed Abu siniyeh** Signature: *Ahmed Abu siniyeh*

Head of Curriculum Committee/Faculty: **Dr. Muayyad Al Hseinat** Signature: *Muayyad Al Hseinat*

Dean**: Prof. Mahmoud Jaghoub** Signature: *Mahmoud Jaghoub*