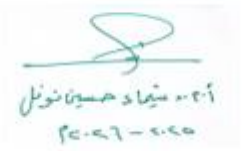
Course Description Template

Course Information			
teaching method	Molecular biology		Course Name
theoretical✓ Laboratory✓ review✓	Basic		Course type
	MPH2202		Course code
	study units 7		Number of units
	175		Number of hours of the course
2	semester	UG II	Course level
Faculty of Science	College	Department of Medical Physics	Academic Department
ali.h@uowa.edu.iq	Email	Ali Hamed Oraibi	Article Officer
Master's	Academic certificate	Assistant teacher	Scientific title
Kara.h.obaid@uowa.edu.iq	Email	Karrar Hassan Obeid	Subject teacher
ahmed.mo@uowa.edu.iq	Email	Dr. Ahmed Moussa Jaafar	Peer reference name
1.0	Issue	1-2-2026	Date of approval by the Scientific Committee

Relationship with other courses			
UG First Semester - 1	semester	General Biology	Prerequisite for the course
without	semester	without	Requirements accompanying the material



Course objectives, learning outcomes, and guidance content	
1. Understanding the basic principles and historical development of molecular .biology 2. ,Describe the structure and function of DNARNA , .and proteins within the cell 3. Explaining the mechanisms of replication, transcription, and translation in .eukaryotic cells 4. Analysis of the types of genetic mutations and their impact on gene function .and cell behavior 5. .Understanding cell cycle regulation and key DNA repair pathways 6. .Identifying the molecular effects of ionizing radiation on DNA and proteins 7. , Performing basic laboratory techniques such as DNA/RNA extraction) centrifugation , polymerase chain reactionPCR .and electrophoresis ,(8. Measurement and evaluation of the purity of nucleic acids and proteins using .spectrophotometric methods 9. Understanding the principles of molecular imaging and gene therapy in .medical applications 10. ,Linking the concepts of molecular biology to medical physics .especially in diagnosis and radiation therapy	Subject objective

:By the end of this unit, students will be able to 1. Defining and explaining the basic concepts in molecular biology and their importance in medical science. 2. Describe the structure and function of nucleic acidsDNA andRNA and proteins. 3. Explaining the molecular processes of DNA replication, transcription, and translation. 4. Identifying the different types of genetic mutations and their biological consequences. 5. Understanding the mechanisms of DNA repair and cell cycle regulation. 6. Analysis of the effects of ionizing radiation on genetic material at the molecular level. 7. Applying knowledge of molecular biology in the context of medical imaging, radiation therapy, and cancer treatment. 8. Demonstrate proficiency in basic laboratory techniques for molecular biology. 9. Evaluating the concentration and purity of nucleic acids and proteins using spectrophotometry. 10. Interpreting the results of molecular experiments such as polymerase chain reactionPCR and gel electrophoresis.	Learning outcomes of the subject matter
Theoretical lectures :Learn the concepts of each lecture or series of lectures. [Minimum credit hours [hours 28 Week First : Introduction in Biology molecular Its importance in Physics ◆ Medical [2 hours] .Definition of molecular biology and its historical development - Some classic experiments that led to the identification of DNA -as a carrier of genetic information. .Experimental modeling in molecular biology and the Human Genome Project -	Guidance content

.Exploring the role of molecular biology in medical physics -) Week Second : Structure acid Nucleic acid ◆ DNA) and ribonucleic acid (RNA [hours 2] (Chemical structure and components of -DNA and . RNA Differences between DNA -and RNA .in structure and function .Directionality (from 5' to 3'), hydrogen bonding, and base coupling The physical properties of the double helix of DNA -and the types of . RNA Week Third : Structure chromosomes packaging acid Nuclear [2 hours] ◆ Definition of chromosomes, their types and functions - .Differences in chromosome structure in viruses, prokaryotes, and eukaryotes - .Levels of DNA packaging in the nucleus - . The role of histones in nucleosome formation - Week Fourth : Doubling acid nuclear and maintenance Telomeres [2 hours] ◆ .Steps of DNA replication in eukaryotes - . Main enzymes: DNA polymerase , helicase , ligase , and primase - .Synthesis of the leading and lagging chains - .Telomere function Telomerase in aging and cancer Week Fifth : Stages Copying in Real The core [two hours] ◆ .Three main phases: initiation, extension, and termination - The role of RNA polymerase -II .and transcription factors .Stimulants, enhancers, and inhibitors - . Messenger RNA processing: coating, splicing, and polyadenine appendage - Week 6: Translation and amendments what after Translation [2 hours] ◆ .An overview of protein synthesis - .The role of ribosomes , messenger RNA, transfer RNA, and amino acids - Post-translation modifications: phosphorylation, glycosylation , and - . acetylation The importance of post-translational modifications in protein activity and - .diseases Week 7: Exam Mid the chapter Academic [hour One ◆ .It covers topics from week 1 to week 6 Week 8: Structure Protein, And his job, Its uses in Treatment Radiation [2 ◆ [hours .Four levels of protein structure: from primary structure to quaternary structure - The relationship between structure and function. - Radiation-sensitive - .proteins and their medical applications	

.Using proteins as biomarkers in radiation therapy for tumors -] Week 9: Dynamics Protein : folding, And metamorphosis , Decomposition ◆ [two hours .Mechanisms of protein folding and molecular companions - .Diseases associated with incorrect protein folding - .Protein denaturation .The process of protein breakdown - Week 10: Types mutations and factors The cause She has [two hours] ◆ . Point mutations, insertions, deletions, and frame shifts - .Causes: radiation, chemicals, biological mutagens , and replication errors - .Silent mutations versus harmful mutations Week 11: Organization turn cell and paths repair acid Nuclear [2 hours] ◆) Stages of the cell cycle -G1 ,S ,G2 ,M .( ) Checkpoints -CDKs .( ) DNA repair mechanisms: base excision repairBER), nucleotide excision repair)NER) base mismatch repair ,(MMR) homologous recombination ,(HR non- ,( ) heterozygous splicing repairNHEJ .(Key proteins such as -p53 .and their role in the response to radiation Week 12: Mechanisms molecular to damage acid nuclear Output on ◆ Radiation [2 hours] .Direct and indirect DNA damage caused by ionizing radiation) Reactive oxygen species -ROS .and their effects (.Single and double chain breaks - .The cellular response to radiation at the molecular level - Week 13: Techniques Photography molecular in Physics Medical [2 hours] ◆ .Introduction to molecular imaging - .Use of radioactive tracers and molecular probes - .Understanding molecular changes through imaging in diagnosis and treatment Week 14 : Biology molecular For cancer [two hours] ◆ .The genetic and molecular basis of cancer - .Oncogenes, tumor suppressor genes, and mutation pathways - The distinctive features of cancer: blood vessel formation, evasion of - .programmed cell death, etc Week 15 : Treatment Genetic Targeting molecular in treatment Cancer [2 ◆ [hours .Defining gene therapy and understanding how it works -	

.Describe the different types and techniques of gene therapy -
.Explanation of molecular targeting and its role in cancer treatment -
Determining the contribution of medical physics to targeted cancer -

.treatments

Laboratory lectures

] .Learn the concepts from each lab or lecture groupSSWL = 30 [hours

Week First : Introduction in Technologies molecular Safety Laboratory [2 ◆

[hours

An overview of molecular biology laboratory equipment and its functions -

General laboratory rules, safety protocols, and personal protective equipment

Chemical, biological, and radiological safety in the molecular biology laboratory

Proper disposal of biological and chemical waste -

Week Second : Principle parcel Central and its applications Its types [two ◆
[hours
,Basic principles of centrifugation (relative centrifugal force, rotational speed -
and time)
Types: Differential centrifugation, density gradient centrifugation, and
ultracentrifugation
Practical training: Balancing and using a centrifuge -
Week Third : Agriculture Bacteria - Isolation Preparation farms Pure [2 ◆
[hours
Types of growing media (nutrient agar, broth) -
.The planning process involves pouring methods into dishes to isolate DNA -
Nursery and study of colony morphology -
Week 4: Preparation solutions The organization The detectors [two hours] ◆
The role of buffer solutions in maintaining the pH of biological reactions
Calculating the molar concentration and components of the buffer solution
,Preparation of common buffer solutions (e.g., phosphate saline solution -Tris-
HCl solution (
Week 5: Extraction acid nuclear from cells Bacterial [2 hours] ◆
Steps in DNA extraction: cell lysis, protein removal, DNA precipitation -
) Use of enzymes -lysozyme) and detergents (SDS (

DNA precipitation using ethanol orisopropanol Week 6: Extraction acid nuclear from cells Real nucleus (cells blood ◆ Humanity - Part First [two hours] Blood sample collection and safety considerations Isolation of white blood cells Cell lysis and enzymatic digestion (e.g., proteinases)K (Week 7: Extraction acid nuclear from cells Real nucleus (cells blood ◆ Humanity - Part The second [two hours] Monitoring the DNA extraction process - DNA precipitation and purification DNA extraction and storage Week 8: Focus acid nuclear ◆ DNA and RNAwere analyzed and quantified .using ultraviolet and visible spectroscopy [Two hours] Principle of measuring the quantity of nucleic acids using ultraviolet absorption Calculating the concentration (ng / µL) usingA260 Purity verification usingA260/A280 andA260/A230 ratios DNA andRNA spectra) Week 9: The Concept Basic For interaction polymerase Sequencing ◆ PCR (and reverse transcription [Two hours]) Principle of polymerase chain reactionPCR and thermal cycles ( ) Components of the polymerase chain reaction -PCR) (,template , primersTaq (polymerase Applications in diagnosis and research Week Tenth : Analysis Journey Electrician [2 hours] ◆ Principle of gel electrophoresis - The role of agarose and electric current DNA/RNA bundles using safe dyes (such asSYBR Safe (Week atheistic Ten : Journeys electrician on jelly Agarose - Part First [two ◆ [hours Gel casting and sample loading techniques Preparation of -TAE/TBE solution Week the second Ten : Journeys electrician on jelly Agarose - Part The ◆ second [two hours]) Practical application of electrophoresis using polymerase chain reaction -PCR) products or genomic DNA	

Using a gel documentation system - Interpretation of electrophoresis results Week the third Ten : Extraction and purification proteins Original [2 hours] ◆ The concept of protein extraction from cells (bacterial or tissue samples) - Use of buffer solutions, protease inhibitors , and mechanical decomposition - (ultrasonic treatment) Week 14 : Chapter and appreciation proteins With technologies ◆ Chromatography [2 hours] Introduction to Chromatography: Principles and Types Column chromatography (ion exchange, gel filtration, convergence) - Separation based on size, charge, or qualitative relationship -) Week 15 : Chromatography The class The Thin ◆ TLC [hours 2] (Principle of thin-layer chromatography and capillary action Sample placement and solvent selection Photography using iodine, ultraviolet light, or staining - Total hours = 28 + 30 + 1 + 3 = 62 hours	

Teaching and learning strategies	
:Teaching methods and techniques 1. : Classroom lectures ,These include interactive learning through classroom discussions group work, video presentations, and practical problem-solving during .the lecture 2. : Basic exercises and resources Basic exercises and documents are assigned as homework, and their .solutions are reviewed during the lecture 3. Tutorials: **Small sessions led by** a ,teacher that allow students to ask questions, receive individual support .and clarify concepts covered in lectures or readings	Strategies

4. Seminars: ,Small groups of students participate in discussions . presentations, and collaborative activities related to the course content 5. Laboratory Sessions: In scientific, engineering, and other experimental disciplines, laboratory sessions provide an opportunity for students to apply theoretical .knowledge through practical experiments and investigations 6. Reflective practice**includes** reflective exercises, such as journaling, self-assessments, or group meditation, to ,encourage students to think critically about their learning process identify areas that need improvement, and connect new knowledge to .their personal experiences 7. : Online learning platforms With the rise of online education, many university courses are integrating online learning platforms, such as Learning Management) SystemsLMS or virtual classrooms. These platforms offer a variety of (.resources, including readings, videos, quizzes, and discussion forums	

Student work load			
4.8	Scheduled hours (hours/week)	76	Scheduled hours (hours/semester)
6.9	Unscheduled hours (hours/week)	99	Unscheduled hours (hours/semester)
final = 175 3 + 172			Total (hours/semester)

Course evaluation					
Learning outcomes	Weeks	Weight (degrees)	Time/Number		
1,6,7	2.10	10 %	2	Tests	

2, 4, 9, 10	9.10	5%	1	a report	Formative assessment
	5	10%	1	College duties	
8	13	5%	1	Reports	
1,2,3,4,5	8	10%	1	Midterm exam	**Final assessment**
1,2,3,4,5,6,7,8,9,10	16	50%	1	Final exam	
		100% 100) (degrees	Overall rating		

Teaching plan (weekly curriculum)	
Course of Study	
History and Introduction to Molecular Biology	Week 1
DNA and RNA structureRNA	Week 2
Chromosome structure and DNA packaging	Week 3
DNA replication and telomere maintenance	Week 4
Stages of transcription in eukaryotes	Week 5
Translation and post-translation revisions	Week 6
Midterm exam	Week 7
Protein structure and function	Week 8
Protein folding, modification, and processing	Week 9
Types of mutations and their causative factors	Week 10
Regulation of the cell cycle and DNA repair pathways	Week 11
Molecular mechanisms of radiation-induced DNA damage	Week 12
Molecular imaging techniques in medical physics	Week 13
Molecular biology of cancer	Week 14

Gene therapy and molecular targeting in cancer treatment	Week 15

Teaching plan (practical weekly curriculum)	
Course of Study	
Introduction to Molecular Techniques and Laboratory Safety	Week 1
Principle, applications, and types of centrifuges	Week 2
Bacterial culture (isolation and preparation of a pure bacterial culture)	Week 3
Preparation of buffer solutions and reagents	Week 4
Extracting DNA frombacterial cells	Week 5
Extraction of DNAfrom eukaryotic cells (human blood cells)I	Week 6
Extraction of DNAfrom eukaryotic cells (human blood cells)II	Week 7
DNA andRNA concentrations using ultraviolet-visible spectroscopy	Week 8
) Basic concepts of polymerase chain reactionPCR and reverse transcription (	Week 9
Electrophoretic migration analysis	Week 10
Electrophoresis with agarose gelI	Week 11

Electrophoresis with agarose gelII	Week 12
Extraction and purification of natural proteins	Week 13
Separation and quantification of proteins using chromatographic techniques	Week 14
) Thin-layer chromatographyTLC (	Week 15

Educational and teaching resources		
?Is it available in the library	Text	
both	**Molecular Biology, Third Edition, David P. Clark, Nanette J. Pazdernik and Michelle R. McGehee, 2019**	Essential/Required Books
both	**Fundamental Molecular Biology Lizabeth A. Allison, 2007**	Recommended books
MedlinePlus: Genetics **Genetics Home Reference** Page not found - CSHL DNA Learning Center **DNA Learning Center**		Websites

Grade distribution plan				
Appreciation	Estimate **%**	Appreciation	Degree	The group
Excellent performance	90 - 100	privilege	**A** Excellent -	Total Success **(50 - 100)**
Above average with some errors	80 - 89	very good	**B** Very good -	
Good work with some noticeable errors	70 - 79	good	**C** Good –	
Acceptable but with significant shortcomings	60-69	middle	**D** Accepted -	
.The work meets minimum standards	50-59	acceptable	**E** / Sufficient - Satisfactory	
It requires more work, but the student is .awarded the degree	(45-49)	Sediment under) (processing	**FX** Deposit - (Under Processing)	Total failure **(0 – 49)**

It requires a great deal of work	(0-44)	Precipitate	**F** Precipitate -	

:note

Decimal marks greater than or less than 0.5 will be rounded up to the nearest whole mark (e.g., 54.5 will be rounded up to 55, while 54.4 will be rounded up to 54). The university has a zero-tolerance policy for near-passing grades, so the only adjustment to the marks awarded by the original examiner(s) will be the automatic rounding described . above