كلية الطب البشري
The faculty of medicine

الجامعـــــــــة الهاشميـــــــــة
The Hashemite University

Principles of Genetics and Molecular Biology Booklet

Academic Year: 2025/2026

Course code: 111501201

Table of Contents

Syllabus: Principles of Genetics and Molecular Biology (111501201)
First Semester 2025/2026

COURSE INFORMATION	
Course Name: principles of Genetics and Molecular Biology **Semester:** First **Department:** Department of Anatomy, Physiology and Biochemistry **Faculty:** Faculty of Medicine	**Course Code:** 111501201 **Section:** All **Core Curriculum**: MD program
Day(s) and Time(s): Sun: 9.30-11.30 Tue: 10.30-12.30 Thu: 10.30-12.30 **Classroom:** Faculty of medicine Auditorium	**Credit Hours:** 3 **Prerequisites**: None

COURSE DESCRIPTION

- Knowledge of the structure and function of nucleic acids is essential in understanding genetics and many aspects of pathophysiology as well as the genetic basis of disease, so nucleic acid (DNA &RNA) structure and function will be covered in details at the beginning of this course.
- The DNA in each and every cell is two meters long, how is this genetic material compacted to fit inside the cell nucleus without becoming a tangled mess? This course will cover in details how DNA is organized into chromosomes?
- This course covers the process of DNA replication and how it is rigidly controlled both in prokaryotes and eukaryotes
- The molecular biology revolution firmly established the role of DNA as the primary carrier of genetic information and proteins as the primary effector molecules of the cell. The intermediate between DNA and proteins is RNA, which initially was regarded as the "molecule in the middle" of the central dogma. This view has been transformed over the past two decades, as RNA has become recognized as a critical regulator of cellular processes. This course introduces the basic principles of RNA synthesis both in prokaryotes and eukaryotes, RNA processing and modification and regulation of gene expression both in prokaryotes and eukaryotes

- The maintenance of the integrity of the information in DNA molecules is of utmost importance to the survival of a particular organism as well as to survival of the species. Thus, it can be concluded that surviving species have evolved mechanisms for repairing DNA damage. Where does this damage come from, and what are its consequences? What are the differences in the molecular blueprint between individuals who can sustain attacks on DNA and remain healthy compared to those who become sick? This course will cover the major sources of DNA damage, the types of DNA damage that can occur, and some of the mechanisms by which cells can repair DNA damage
- It was impossible to understand protein synthesis-or to explain mutations- before the genetic code was elucidated. This course covers the Characteristics of the genetic code and introduces the basic principles of protein synthesis (translation).
- This course covers different genetic diseases including Chromosomal disorders (numerical & structural changes), mitochondrial disorders, monogenic disorders and their mode of inheritance and multigenic disorders.
- This course covers different stages of the cell cycle and the basic cell cycle machinery, cell cycle control of DNA replication and cell cycle check points. It also covers the basic principles of apoptosis.
- Cancer is a leading cause of death worldwide. Cancer involves uncontrolled cell growth, resistance to cell death, failure to differentiate into a particular cell type, and increased cellular motility. This course covers the molecular genetics of cancer, highlighting the genes commonly altered in cancer (oncogenes and tumor suppressor genes).
- This course covers the concepts and techniques of genetics & molecular biology including recombinant DNA technology, polymerase chain reaction and DNA sequencing.
- Finally, the course covers principles of gene therapy.

DELIVERY METHODS

The course will be delivered through a combination of active learning strategies. These will include:

- PowerPoint lectures and active classroom-based discussion
- Relevant papers and reading materials
- E-learning resources: e-reading assignments and practice quizzes through Microsoft Team

FACULTY INFORMATION

Name	**Dr. Walaa BayoumieEl Gazzar**
Academic Title:	**Associate Professor**
Office Location:	**Faculty of Medicine, 3rd floor, Room 3032**
Telephone Number:	**5416**
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Office Hours:	**Sunday** 11.30-1.30 **Tuesday** 9.30-10.30
Name	**Dr. Ahmed Salem**
Academic Title:	**Assistant Professor**

Email Address:	**asalem@hu.edu.jo**
Office Location:	**Faculty of Medicine, ground floor, Room 1019**
Office Hours:	**Sunday** 9.00-12.00 **Thursday** 9.00-12.00

REFERENCESAND LEARNINGRESOURCES

Molecular Biology

Required Textbook:

James Watson , Tania Baker , Stephen Bell , Alexander Gann , Michael Levine , Richard Losick . ***Molecular Biology of the Gene*** (Pearson; 7th edition (February 20, 2013)). ISBN-10 : 0321762436, ISBN-13 : 978-0321762436

Suggested Additional Resources:

Thomas M. Devlin. ***Textbook of Biochemistry with Clinical Correlations*** (John Wiley & Sons; 7th edition (January 19, 2010). ISBN-10 : 0470281731, ISBN-13 : 978-0470281734

https://web.mit.edu/mitxbio/courses.html
https://web.mit.edu/mitxbio/video.html

STUDENT LEARNING OUTCOMES MATRIX*

Program Learning Outcomes	Course Objectives	Course Student Learning Outcomes	Assessment Method
D1 D5	**I-Biomedical:** **Develop an understanding of**: The central dogma of molecular biology. Nucleic acid structure and function	**By the end of the course, the student should be able to:** • Describe the structure of DNA and RNA, explaining the difference between the constituent bases, sugars, nucleosides and nucleotides. • Describe the 1ry, 2ry and tertiary DNA structure; Packaging of DNA into chromatin and chromosome forms ,Gene arrangement and locations on the chromosome • Point out the diverse types and functions of different RNA species.	• **MCQ Exams**
D1 D5 D6 E2	DNA replication, mutation and repair	• Describe the process of replication, point out the replication machinery and pathways that protect the fidelity of DNA synthesis. • Interpret and describe the end replication problem & the Special replication of telomere endsand relate telomere dynamics to aging and disease.	

		• Compare and contrast the mechanisms of DNA replication in prokaryotes and eukaryotes • Define and describe different types of mutations that occur in DNA and their effects. • Describe several enzymatic mechanisms that the cell uses to repair or tolerate DNA damage. Give examples of Diseases caused by defective DNA repair	
D1 D5 D6 E2	RNA Synthesis, Processing, & Modification	• Describe the process of transcription, compare and contrast RNA synthesis in both prokaryotes and eukaryotes • Describe the posttranscriptional processing of eukaryotic mRNA, and how diseases may result from alterations in the processing steps and cite examples.	
D1 D5 D6 E2	Regulation of gene expression	• Describe how gene expression is regulated in both prokaryotes and eukaryotes. • Explain that the many steps involved in the processes of gene expression, which range from targeted modulation of gene copy number, to gene rearrangement, to transcription, to mRNA processing and transport from the nucleus, to translation, to protein subcellular compartmentalization, to posttranslational modification and degradation, are all subject to regulatory control, both positive and negative. Changes in any, or multiple of these processes, can increase or decrease the amount and/or activity of the cognate gene product.	
D1 D5 D6 E2	Protein Synthesis & the Genetic Code	• Define genetic code & its features and biological relevance • Learn how to Use the genetic code to predict the amino acid sequence of a protein for a given nucleic acid sequence and how nucleotide mutations can lead to alterations in the primary structure of a protein. • Describe the three steps of translation: initiation, elongation, and termination and contrast these processes and their regulation in eukaryotic and prokaryotic cells. • Describe the posttranslational modifications	

D1 D5 D6 E2	The molecular basis for cell cycle regulation& Cell cycle check points	• Describe the components and regulation of the cell cycle, understanding how the process of DNA replication is regulated throughout the cell cycle and what happens when DNA replication goes awry. • Point out DNA damage checkpoints. • Describe The events that can trigger cell apoptosis & the main constituents of the apoptotic machinery	
D1 D5 D6 E1 E2	Genetic diseases	• Explain causes, detection and consequences of genetic diseases (chromosomal, mitochondrial, monogenic and multigenic disorders). • Describe Mode of inheritance for mitochondrial& monogenic disorders	
D1 D5 D6 E1 E2	Molecular genetics of cancer cells	• Discuss genetic Pathways in Cancer & point out Genes within these pathways: tumor suppressor genes and proto-oncogens & oncogenes.	
D1 D2 D5 D6 E1 E2	Molecular Genetics, Recombinant DNA, & Genomic Technology	• Point out the steps involved in a basic cloning strategy & the applications of recombinant DNA technologies. • Understand what an agarose gel is and how to use agarose gel electrophoresis to analyze DNA molecules. • Describe the basic mechanism of DNA sequencing by the dideoxy chain termination method. • Describe the basic mechanism of the polymerase chain reaction (PCR) method of amplifying DNA and know when to use this technique. • Interpret the photographs of electrophoresis runs of Polymerase chain reaction (PCR) products. • Describe the principles, methods, and applications of Northern, Southern and Western blot	
E1-E5	**II-Critical thinking**: 1-Observe, identify and predict health problems based on previous experience and make decisions based on evidence rather than opinion 2- Draw conclusions about the collected data (inference). 3- Maintain good communication habits,		

	such as active listening and respect. 4-Improve problem-solving skills. 5-Demonstrate knowledge of resources and tools available to support lifelong learning.	

ACADEMIC SUPPORT

It is The Hashemite University policy to provide educational opportunities that ensure fair, appropriate and reasonable accommodation to students who have disabilities that may affect their ability to participate in course activities or meet course requirements. Students with disabilities are encouraged to contact their instructor to ensure that their individual needs are met. The University through its Special Need section will exert all efforts to accommodate for individual's needs.

Special Needs Section: Student service and care unit
Tel:053903333 ext. 4132/4583/ 5023
Location: Deanship of Students Affairs
Email: stydent@hu.edu.jo

COURSE REGULATIONS

Participation
Class participation and attendance are important elements of every student's learning experience at The Hashemite University, and the student is expected to attend all classes. A student should not miss more than 15% of the classes during a semester. *Those exceeding this limit of 15% will receive a failing grade regardless of their performance*. It is a student's responsibility to monitor the frequency of their own absences. **Attendance record begins on the first day of class irrespective of the period allotted to drop/add and late registration. It is a student's responsibility to sign-in; failure to do so will result in a non-attendance being recorded.**

In exceptional cases, the student, with the instructor's prior permission, could be exempted from attending a class provided that the number of such occasions does not exceed the limit allowed by the University. The instructor will determine the acceptability of an absence for being absent. A student who misses more than 25% of classes and has a valid excuse for being absent will be allowed to withdraw from the course.

Plagiarism
Plagiarism is considered a serious academic offence and can result in your work losing marks or being failed. HU expects its students to adopt and abide by the highest standards of conduct in their interaction with their professors, peers, and the wider University community. As such, a

student is expected not to engage in behaviours that compromise his/her own integrity as well as that of the Hashemite University.

Plagiarism includes the following examples and it applies to all student assignments or submitted work:

- **Use of the work, ideas, images or words of someone else without his/her permission or reference to them.**
- **Use of someone else's wording, name, phrase, sentence, paragraph or essay without using quotation marks.**
- **Misrepresentation of the sources that were used.**

The instructor has the right to fail the coursework or deduct marks where plagiarism is detected

Late or Missed Assignments

In all cases of assessment, students who fails to attend an exam on the scheduled date without prior permission, and/or are unable to provide a medical note, will automatically receive a fail grade for this part of the assessment.

- In cases where a student misses an assessment on account of a medical reason or with prior permission; in line with University regulations an incomplete grade for the specific assessment will be awarded and an alternative assessment or extension can be arranged.

Student Complaints Policy

Students at The Hashemite University have the right to pursue complaints related to faculty, staff, and other students. The nature of the complaints may be either academic or non-academic. For more information about the policy and processes related to this policy, you may refer to the students' handbook.

COURSE ASSESSMENT

Course Calendar and Assessment

Students will be graded through the following means of assessment and their final grade will be calculated from the forms of assessment listed below with their grade weighting taken into account. The criteria for grading are listed at the end of the syllabus

Assessment	Grade Weighting	Deadline Assessment
Mid Exam	50%	TBD
Final Exam	50%	TBD

Description of Exams

Test questions will predominately come from the material presented in the lectures. Semester exams will be conducted during the regularly scheduled lecture period. **The exam will consist of multiple choice for the regular exam and short assay questions for make-up exams.**

Grades are not negotiable and are awarded according to the following criteria*:

Letter Grade	Description	Grade Points
A+	Excellent	4.00
A		3.75
A-		3.50
B+	Very Good	3.25
B		3.00
B-		2.75
C+	Good	2.50
C		2.25
C-		2.00
D+	Pass	1.75
D	Pass	1.50
F	Fail	0.00
I	Incomplete	-

WEEKLY LECTURE SCHEDULE AND CONTENT DISTRIBUTION 2024-2025

Week	Topics
Week 1 Oct. (5,7,9), 2025	• Introduction • DNA structure • Organization of eukaryotic DNA
Week 2 Oct. (12,14,16), 2025	• DNA replication part I (replication initiation in prokaryotes) • DNA replication part II (replication initiation in eukaryotes) • DNA replication part III (synthesis of leading and lagging strands)
Week 3 Oct. (19,21,23), 2025	• Telomeres and Telomerases / The end replication problem • RNA types • Transcription in prokaryotes
Week 4 Oct. (26,28,30), 2025	• Regulation of prokaryotic gene expression • Synthesis of RNA in eukaryotes
Week 5 Nov. (2,4,6), 2025	• Post transcription modifications • Regulation of eukaryotic gene expression
Week 6 Nov. (9,11,13), 2025	• Characteristics of the genetic code • Protein synthesis (part I)
Week 7 Nov.(16,18,20), 2025	• Protein synthesis (part II) • Post-translational processing of polypeptide chains • Mutations • DNA damage & repair
Week 8 Nov.(23,25,27), 2025	• Genetic diseases (part I) • Genetic diseases (part II)
Week 9 Nov. 30, Dec. (2,4), 2025	• Cell cycle • Apoptosis • Molecular genetics of cancer cells (part I)
Week 10 Dec. (7,9,11), 2025	• Molecular genetics of cancer cells (part II) • Molecular genetics of cancer cells (part III)

Week 11 **Dec. (14,16,18), 2025**	• **Mitochondrial disorders** • **Monogenic, multigenic disorders & Genetic disease penetrance**
Week 12 **Dec. (21,23,25), 2025**	• **Recombinant DNA Technology** • **Polymerase chain reaction**
Week 13 **Dec. (28,30), 2025** **Jan. 1, 2026**	• **Hybridization and blotting techniques** • **DNA sequencing**
Week 14 **Jan. (4,6,8), 2026**	• **Gene therapy**

The midterm exam will be within week 8 and 9.
***** Dates of the exam: TBD***

Code of Practice on Assessment for Genetics & Molecular Biology

I-Formative Assessment
II-Summative Assessment
III-Students feedback

I-Formative Assessment:
Online Quizzes on Microsoft Teams on topics included in the modules.
II-Summative Assessment:
A-Regular exams:
It follows the regulations approved by the faculty of medicine, the Hashemite University. The students will be assessed by two exams: Mid exam and Final exam. The question will assess different cognitive domains (Knowledge, comprehension, application). The questions will be in the form of MCQs.
B-Makeup exams:
Absent students with accepted excuses will have make-up exams in the form of essay questions.
C-Summer exams:
Students may have a resit exam if they don't pass the regular exams at the end of the module or an exam to raise their GPA. The exams will be in the form of MCQs.
III-Students feedback:
Two surveys will be shared with the students: one on teaching process satisfaction and the second on exam questions evaluations.