Syllabus*: Gene Expression (1801042326)

COURSE INFORMATION	
Course Name: Gene Expression **Semester:** **Department:** Department of Biology and Biotechnology **Faculty:** Science	**Course Code:** 1801042326 **Section:** 1 **Core Curriculum**: Biotechnology
Day(s) and Time(s): **Classroom:**	**Credit Hours:** 3 **Prerequisites**: Molecular Biology (1801042322)

COURSE DESCRIPTION

- This course studies the process of gene expression and explores how the information in living cells flows from DNA to RNA to protein.
- Several topics will be covered including the mechanisms of genome condensation, transcription of DNA to mRNA, processing of RNA and translation of mRNA into protein.
- Regulation of gene expression in prokaryotic and eukaryotic cells as well as the mechanisms of post-transcriptional control in eukaryotes will be discussed.
- Finally, the regulation of the eukaryotic cell cycle will be explained.

DELIVERY METHODS

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

- PowerPoint lectures and active classroom-based discussion.
- Accompanying lab that confirms and explains lectures' concepts.
- Collaborative learning through dividing each session in the lab to several groups.
- Video lectures.
- E-learning resources: e-reading assignments and practice quizzes through Model and Microsoft Team.

FACULTY INFORMATION

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REFERENCES AND LEARNING RESOURCES

Required Textbook:

Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Amon A and Scott MP. 2013. Molecular cell Biology. 7th edition, W. H. Freeman and Company, New York, USA.

Lodish H, Berk A, Kaiser CA, Krieger M, Bretscher A, Ploegh H, Amon A and Martin KC. 2016. Molecular cell Biology. 8th edition, W. H. Freeman and Company, New York, USA.

STUDENT LEARNING OUTCOMES MATRIX*

Core Curriculum Learning Outcomes	Program Learning Outcomes	Course Objectives	Course Student Learning Outcomes	Assessment Method
CC-LO-1 Think critically and creatively in a variety of mechanisms in order to make decisions and understand concepts.	BIOTECH-LO-1: Apply critical thinking and demonstrate problem-solving skills.	1. Develop an understanding of the basic molecular genetic mechanisms.	1. Identify the structure and function of the genetic material.	• Exams • Quizzes • Lab reports.
		2. Obtain a thorough knowledge about genomics and chromosomes.	2. Explain the processes of chromosome condensation.	• Exams • Quizzes • "On-line' reading assignments.
		3. Explore the regulation of gene expression in	3.1 Describe the regulatory regions in prokaryotic genomes and how the environmental cues control the expression of genes in bacterial.	• Exams • Quizzes • Homework assignments.

		prokaryotes and eukaryotes	3.2 Elucidate the structure of regulatory regions in eukaryotic genomes, the different RNA polymerases and the interactions between transcription machinery and regulatory regions.	
		4. Uncover the mechanisms underlying post-transcriptional regulation.	4.1 Demonstrate the molecular mechanisms of RNA splicing. 4.2 Describe the Cytoplasmic mechanisms of post-transcriptional control using RNAi and microRNA. 4.3 Explain the processes of cytoplasmic polyadenylation.	• Exams • Quizzes • "On-line' reading assignments
		5. Explore the regulation of gene expression during the transition from one phase to another phase in the cell cycle.	5.1 Explain the roles of Cyclin-Cyclin dependent kinases. 5.2 Describe the entry into mitosis, progress and exist from mitosis.	• Exams • Quizzes • Homework assignments.
CC-LO-2. Communicate competently with others using oral and written English skills.	BIOTECH-LO-2: Use modern literature search methods to obtain information about Biotechnology topics.	6. Obtain an understanding of the role of Biotechnology in other disciplines, and its importance in society.	6. Acquire the ability to learn independently; articulate the importance of independent learning for future professional development	• "On-line" reading assignments
CC-LO-3. Demonstrate competency in the use of research skills and various information sources.	BIOTECH-LO-3: Communicate results to biotechnologists and biologists and others outside the field	7. Acquire positive attitudes towards further studies in biotechnology and towards the application of biotechnology in other disciplines.	7. Develop a positive attitude towards biotechnology and its applications in society, and towards further study and lifelong learning.	• "On-line" reading assignments

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:

Tel:
Location:
Email:

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 (Reports)

In all cases of assessment, students who fails to attend an exam, class project or deliver a presentation 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.

- Submitting a term paper on time is a key part of the assessment process. Students who fail to submit their work by the deadline specified will automatically receive a 10% penalty. Assignments handed in more than 24 hours late will receive a further 10% penalty. Each subsequent 24 hours will result in a further 10% penalty.
- 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 as 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
First Exam	15%	6th or 7th week
Second Exam	15%	11th or 12th week
Laboratory (Reports, Midterm and Final)	30%	All over the semester
Final Exam	40%	16th or 17th week

Description of Exams

Test questions will predominately come from material presented in the lectures. Semester exams will be conducted during the regularly scheduled lecture period. Exam will consist of a combination of multiple choice, short answer, match, true and false and/or descriptive questions.

Laboratory reports: Will be submitted after the determination of DNA and RNA concentration and after Bradford assay.

Laboratory Quizzes: Unannounced quizzes will be given during or/and at the end of any experiment based upon the previous experiments. It will enforce that you come prepared to the lab.

No make-up exams, homework or quizzes will be given. Only documented absences will be considered as per HU guidelines.

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

"Lecture hours and weeks are approximate and may change as needed"

Week	Weekly hours	Topics	Ch. in Text
1,2	4	**Basic molecular genetic mechanisms** 4.1 Structure of nucleic acid - A nucleic acid strand is a linear polymer with end-to-end directionality. - Native DNA is a double helix of complementary antiparallel strands. - Different types of RNA exhibit various conformations related to their functions.	4

		4.2 Transcription of protein-coding genes and formation of functional mRNA. - A template DNA strand is transcribed into a complementary RNA chain by RNA polymerase. - Organization of genes differs in prokaryotic and eukaryotic DNA. - Eukaryotic precursor mRNAs are processed to form functional mRNAs. 4.3 The decoding of mRNA by tRNAs. - Messenger RNA carries information from DNA in a 3 letter genetic code. - The folded structure of tRNA promotes its decoding functions. - Non standard base pairing often occurs between codons and anticodons. - The folded structure of tRNA promotes its decoding functions. 4.4 Stepwise synthesis of proteins on ribosomes - Ribosomes are protein-synthesizing machines. - Methionyl-tRNAi Met recognizes the AUG start codon. - Translation initiation usually occurs at the first AUG from the 5' end of an mRNA. - During chain elongation each incoming aminoacyl-tRNA moves through three ribosomal sites. - Translation is terminated by release factors when a stop codon is reached. - Polysomes and rapid ribosome recycling increase the efficiency of translation.	
3,4,5	6	**Genes, genomics and chromosomes** 6.1 Eukaryotic gene structure. - Most eukaryotic genes contain introns and produce mRNAs encoding single proteins. - Simple and complex transcription units are found in eukaryotic genomes. - Protein-coding genes may be solitary or belong to a gene family. - Nonprotein-coding genes encode functional RNAs. 6.2 Chromosomal organization of genes and noncoding DNA. - Genomes of many organisms contain much nonfunctional DNA. - Most Simple Sequence DNAs are concentrated in specific chromosomal locations.	6

		- Unclassified Spacer DNA Occupies a Significant Portion of the Genome. 6.3 Transposable (mobile) elements. - Movement of Mobile Elements Involves a DNA or an RNA Intermediate. - DNA Transposons are Present in Prokaryotes and Eukaryotes. - LTR Retrotransposons Behave Like Intracellular Retroviruses. - Non-LTR Retrotransposon Transpose by a Distinct Mechanism. - Mobile DNA Elements Have Significantly Influenced Evolution. 6.6 Structural organization of eukaryotic chromosomes. - Chromatin exists in extended and condensed forms structure of nucleosome. - Modifications of histone tails control chromatin condensation and function. - Nonhistone Proteins Organize Long Chromatin Loops. - Additional nonhistone proteins regulate transcription and replication.	
6	2	**Transcriptional Control of Gene Expression** 7.1 Control of Gene Expression in Bacteria. - Transcription initiation by bacterial RNA polymerase requires association with a sigma factor. - Initiation of lac operon transcription can be repressed and activated. - Transcription initiation from some promoters requires alternative sigma factors. - Transcription by σ54 – RNA polymerase is controlled by activators that bind far from the promoter. - Many bacterial responses are controlled by two-component regulatory systems. - Control of transcription elongation.	7
7,8,9	6	**Transcriptional control of gene expression** 7.2 Overview of eukaryotic gene control and RNA Polymerase. - Regulatory elements in eukaryotic DNA are found both close to and many kilobases away from transcriptional start site. - Three RNA polymerases catalyze formation of different RNAs.	7

		7.3 RNA polymerase II promoters and general transcription factors. - The TATA Box, Initiators, and CpG Islands Function as Promoters in Eukaryotic DNA. - General transcription factors position RNA Polymerase II at start site and assist in initiation. 7.4 Regulatory sequences in protein coding genes and the proteins through which they function. - Promoter proximal elements help regulate eukaryotic genes. - Distant enhancers often stimulates transcription by RNA polymerase II. - Most eukaryotic genes are regulated by multiple transcription control elements. - Activators promote transcription and are composed of distinct functional domains. - Repressors inhibit transcription and are the functional converse of activators. - Multiprotein complexes form on enhancers. 7.5 Molecular mechanisms of transcription repression and activation. - Formation of heterochromatin silence gene expression at telomeres, near centromeres, and in other regions. - Chromatin-remodeling factors help activate or repress transcription. - The mediator complex forms a molecular bridge between activation domain and Pol II. 7.6 Regulation of transcription factor activity. - Metazoans regulate the Pol II transition from initiation to elongation. - Pol II termination is also regulated. 7.7 Epigenetic regulation of transcription. - Epigenetic control by polycomb and trithorax complexes.	
10,11	4	**Post-transcriptional gene control** 8.1 Processing of Eukaryotic Pre-mRNA. - Processing of eukaryotic pre-mRNA. - Splicing occurs at short conserved sequences in pre-mRNAs via two transesterification reactions. - During splicing, snRNAs base-pair with pre-mRNA. - Spliceosomes, assembled from snRNPs and a pre-mRNA, carry out splicing.	8

		- Chain elongation by RNA polymerase II is coupled to the presence of RNA-processing factors. - SR proteins-contribute to exon definition in long pre-mRNAs. - 3' cleavage and polyadenylation of pre-mRNAs are tightly coupled. 8.4 Cytoplasmic mechanisms of post-transcriptional control. - Micro RNAs repress translation of specific mRNAs. - RNA interference induces degradation of precisely Complementary mRNAs. - Cytoplasmic polyadenylation promotes translation of some mRNAs.	
12,13,14	6	**Regulating the eukaryotic cell cycle** 19.1 Overview of eukaryotic cell cycle and its control. - The cell cycle is an ordered series of events leading to cell replication. - Cyclin dependent kinases control the eukaryotic cell cycle. - Several key principles govern the cell cycle. 19.4 Commitment to the cell cycle and DNA replication. - Cells are irreversibly committed to cell division at a cell cycle point called START. - The E2F transcription factor and its regulator Rb control the G1-S phase transcription in metazoans. - Degradation of an S phase CDK inhibitor triggers DNA replication. - Replication at each origin is initiated once and only once during the cell cycle. - Duplicated DNA strands become linked during replication. 19.5 Entry into Mitosis - The mitotic CDKs promote nuclear envelope breakdown. - Mitotic CDKs promote mitotic spindle formation. - Chromosome condensation facilitates chromosome segregation. 19.6 Completion of mitosis: chromosome segregation and exist from mitosis. - The APC/C activates separase through securing ubiquitinylation. - Mitotic CDK inactivation triggers exist from mitosis. - Cytokinesis creates two daughter cells.	19

15	2	Revision	

ASSESSMENT FABRICS					
Classroom Participation: Assessment Criteria					
Criteria	**Quality**				**Score**
	Excellent (4 points)	**Good (3 points)**	**Satisfactory (2 points)**	**Needs Improvement (1 points)**	
Degree to which student integrates course readings into classroom participation	- often cites from readings; - uses readings to support points; - often articulates "fit" of readings with topic at hand.	-occasionally cites from readings; - sometimes uses readings to support points; -occasionally articulates "fit" of readings with topic at hand.	-rarely able to cite from readings; - rarely uses readings to support points; - rarely articulates "fit" of readings with topic at hand	-unable to cite from readings; -cannot use readings to support points; cannot articulates "fit" of readings with topic at hand.	
Interaction / participation in classroom discussions	-always a willing participant, responds frequently to questions; - routinely volunteers point of view.	-often a willing participant, - responds occasionally to questions; - occasionally volunteers point of view.	-rarely a willing participant, - rarely able to respond to questions; - rarely volunteers point of view.	-never a willing participant., - never able to respond to questions; - never volunteers point of view.	
Interaction /participation in classroom learning activities	-always a willing participant; -acts appropriately during all role plays; - responds frequently to questions; - routinely volunteers point of view.	-often a willing participant; -acts appropriately during role plays; - responds occasionally to questions; -occasionally volunteers point of view.	-rarely a willing participant. -occasionally acts inappropriately during role plays; - rarely able to respond to direct questions; -rarely volunteers point of view.	-never a willing participant - often acts inappropriately during role plays;, - never able to respond to direct questions; - never volunteers point of view.	
Demonstration of professional attitude and demeanor	-always demonstrates commitment through thorough preparation; - always arrives on time;	- rarely unprepared; rarely arrives late; - occasionally solicits instructors' perspective outside class.	-often unprepared; occasionally arrives late; - rarely solicits instructors' perspective outside class.	-rarely prepared; - often arrives late; -never solicits instructors' perspective outside class	

	- often solicits instructors' perspective outside class.				