The University of Jordan

Faculty: Medicine **Department:** Physiology and Biochemistry
Semester: Summer **Academic Year:** 2018-2019
Course Name: Principles of Genetics and molecular biology
Course Number: 0501217

Credit hours	**3**	**Level**	**2**	**Prerequisite**	**None**
Coordinator/ Lecturer	Prof. Mamoun Ahram Prof. Said Ismail Dr. Nafez Abu Tarboush Dr. Diala Abu Hassan Dr. Bilal Azab	**Office number**		**Office phone**	
Course website		**E-mail**		**Place**	

Office hours					
Day/Time	**Sunday**	**Monday**	**Tuesday**	**Wednesday**	**Thursday**
	TBD	TBD	TBD	TBD	TBD

Course Description

This is a three-credit hour course mandatory for second-year medical students. The course is designed to introduce medical students to the basics of cellular and molecular biology and medical genetics. The basics include the study of cell structure and the function of cell components, , the chemical structure of the genetic material, molecular processes such as replication, transcription, and translation, in addition to the study of basic molecular biology tools and techniques. The course also introduces students to the main principles of medical genetics in relation to chromosomal structure and anomalies, patterns of inheritance, and genetic disorders.

Learning Objectives

The overall objective is to: 1) cell organization and function of the different components and abnormalities, 2) learn the basic processes of the central dogma of molecular biology including DNA replication, RNA transcription, and protein translation. 2) become familiar with basic molecular biology techniques involved in recombinant DNA technology, and 3) learn the genetic basis and the principles of disease inheritance.

Intended Learning Outcomes (ILOs):

Successful completion of the course should lead to the following outcomes:

A. Knowledge and Understanding: Student is expected to

A1- Recognize the different cell models.
A2- Learn the molecular components of cells.
A3- Understand the structure of plasma membranes of eukaryotic cells.
A4- Know the different types of membrane proteins.
A5- Recognize the role of membrane proteins in transport.
A6- Understand the molecular mechanism of cystic fibrosis.
A7- Understand the structure and role of the endoplasmic reticulum in protein synthesis and sorting.
A8- Understand the role of the endoplasmic reticulum in lipid synthesis.
A9- Understand the structure and roles of the Golgi apparatus in the synthesis of cellular molecules.
A10- Understand the mechanism of vesicular transport.
A11- Understand the structure and role of lysosomes and endosomes.
A12- Understand the mechanism of endocytosis.
A13- Recognize lysosomal storage diseases.
A14- Understand the structure of the mitochondria.
A15- Discuss mitochondrial diseases.
A16- Understand the structure and function of peroxisomes.
A17- Understand the structure of the nucleus and the nuclear membrane.
A18- Know the nuclear lamina diseases.
A19- Understand the structure and organization of the actin cytoskeleton.
A20- Understand the role of actin and myosin in cell movement and muscle contraction.
A21- Understand the structure and organization of microtubules and their role in vesicular transport.
A22- Understand the structure and role of intermediate filaments.
A23- Know the association of keratin dysfunction in skin diseases.
A24- Recall the different components of the extracellular matrix.
A25- Recall the steps involving the synthesis of collagen proteins.
A26- Recall diseases related to collagen synthesis.
A27- Understand the mechanisms of cell-matrix and cell-cell interaction.
A28- Recall the different modes of cell signaling with emphasis on cell surface receptors and their intracellular signaling molecules and their cellular effects.
A29- Understand the phases and molecular control of the cell cycle.
A30- Understand the molecular regulation of cell death.
A31- Understand the types and properties of cancer cells.
A32- Recognize the basic features of DNA/RNA structures.
A33- Understand the concept and uses of gel electrophoresis and Southern blotting
A34- Understand the basics of restriction digestion and its use in restriction fragment length polymorphism (RFLP), recombinant DNA technology, and DNA coning
A35- Learn the main steps and reactions involved in DNA replication.
A36- Understand the concept of DNA sequencing and polymerase chain reaction (PCR), and their clinical applications
A37- Recognize the type of DNA mutations
A38- Know and differentiate the mechanisms of DNA repair

A39- Know the composition of the human genome
A40- Learn the main steps and reactions involved in RNA transcription.
A41- Understand the mechanisms of regulating gene expression at the transcriptional level in prokaryotes and eukaryotes
A42- Know the different tools in measuring gene expression at the RNA level starting with single genes (Northern blotting) to high-throughput technologies (DNA microarrays)
A43- Learn the main steps and reactions involved in protein translation.
A44- Understand the function and regulation of cancer-related genes including oncogenes, tumor suppressors, and regulators of apoptosis.
A45- Recognize the main features of chromosome structure.
A46- Recognize the main types of chromosomal aberrations.
A47- Understand the principles, mechanisms and classification of congenital anomalies
A48- Understand the basic principles of chromosomal disorders.
A49- Know how to draw a family pedigree with comprehensive information.
A50- Differentiate between the main patterns of single-gene inheritance.
A51- Understand the basic principles of mitochondrial inheritance
A52- Understand the basic principles of imprinting and trinucleotide repeat expansions and their clinical implications
A53- Understand the basic principles of multifactorial inheritance.
A54- Understand and apply the Hardy-Weinberg equation
A55- Understand the concept of risk assessment
A56- Understand the concept of genome-wide association studies (GWAS)
A57- Focus on biochemical genetics and disorders of metabolism.
A58- Understand the contribution of genetics and genomics to precision medicine
A59- Know the basics of pharmacogenetics and pharmacogenomics.

B. Intellectual Analytical and Cognitive Skills: Student is expected to

B1-Recognize the cellular organelles, their functions, structures, molecular components.
B2-Understand the bases of diseases at the molecular and cellular levels.
B3-Recognize the regulation of cell behavior and abnormalities associated with it.
B4-Recognize the nature of the chemical bonds that compose the DNA and RNA molecules.
B5-Understand how genetic information flow from DNA into RNA and then into functional proteins.
B6-Get familiar with basic tools and techniques involved in genetic engineering.
B7-Interpret data of recombinant DNA technologies.
B8-Understand the molecular basis of oncogenesis.
B9-Differentiate between the different mutations and genetic aberrations and their effect on human disease.
B10- Know how to perform gene mutation/disease association studies.

Teaching/Learning Methods

Teaching Method	**ILO/s**
Lectures and Discussions:	**90%**
Homework and Assignments:	**10%**
Projects:	**0%**
Presentation	**0%**

Course Contents

Topic	No. of lectures	Week	Reference	ILOs
Part I: Molecular Biology				
Nucleic acid structure	1	1	Campbell, Ch. 2, pp. 49-52 Ch. 4, pp. 108-109	A32
Gel electrophoresis and Southern blotting	1	1	Campbell, Ch. 4, pp.118-119, 124-125, 129-130	A33
Restriction endonucleases, RFLP, recombinant DNA technology, and DNA cloning	1	1	Campbell, Ch. 4, pp.118-124	A34
DNA replication	1	2	Campbell, Ch. 4, p. 110 Ch.6, pp. 192-206	A35
PCR and DNA sequencing	1	2	Campbell, Ch. 4, pp.124-125, 127-129	A36
DNA mutations and repair	1	2	Online resource Campbell, Ch.6, pp. 207-219	A37-38
The human genome	1	3	Campbell, Ch.5, pp. 153-163	A39
RNA transcription	2	3	Campbell, Ch. 4, pp. 112-115 Ch. 7, 239-242, 245-251, 277-278, 286-289	A40
Regulation of transcription in prokaryotes and eukaryotes	2	4	Campbell, Ch.7, pp.243-245, 251-255, 260-275, 288	A41
Analysis of gene expression	1	4	Campbell, Ch. 4, pp.130-132	A42
Translation and its regulation	2	5	Campbell, Ch. 8, 297-319	A43
Part II: Genetics				
Structure & function of chromosomes	1	5	Thompson & Thompson Genetics in Medicine, Ch. 2, pp.23-38	A45

Chromosomal aberrations	1	6	Thompson & Thompson Genetics in Medicine, Ch. 5, pp. 174-193	A46
Congenital anomalies	1	6		A47
Patterns of single-gene inheritance	2	6	Thompson & Thompson Genetics in Medicine, Ch. 7, pp. 271-334	A48-50
Non-Mendelian inheritance	2	7		A51-52
Multifactorial inheritance	1	7	Medical Genetics, Ch. 12, pp. 239-247	A53
Population genetics	1	8		A54-55
Biochemical genetics: disorders of metabolism	1	8	Medical Genetics, Ch.7, pp. 132-152	A57
Precision medicine	1	8	Medical Genetics, Ch. 14, pp. 292-300	A58-59
Exams (week 9)				
Part III: Cell Biology				
Introduction into basic cell structure, model systems of cell biology, and eukaryotic cell organelles	1	10	Cooper, Ch.1 (pp. 17-38) and Ch.2 (43-57)	A1-2
Biomembranes and membrane proteins and their role in plasma membrane transport	1	11	Cooper, Ch. 2 (pp. 58-64) Ch. 13 (515-543)	A3-6
Protein sorting and transport, and endoplasmic reticulum	1	11	Cooper, Ch. 10 (373-398)	A7-8
The Golgi apparatus and vesicular transport	1	12	Cooper, Ch. 10 (398-412)	A9-10
Lysosome, endocytosis, endocytosis, and lysosomal storage diseases	1	12	Cooper, Ch. 10 (412-416) Ch. 13 (544-553)	A11-13
Mitochondria and peroxisomes	1	12	Cooper, Ch. 10 (421-431, 450-455)	A14-16
The nucleus	1	13	Cooper, Ch. 9 (345-365)	A17-18
The actin cytoskeleton and cell	1	13	Cooper, Ch. 12	A19-

movement			(459-482)	20
Microtubules and intermediate filaments	1	13	Cooper, Ch. 12 (482-510)	A21-23
The extracellular matrix	1	14	Cooper, Ch. 14 (564-582)	A24-27
Cell signaling	1	14	Cooper, Ch. 15 (589-634)	A28
The cell cycle	1	14	Cooper, Ch. 16 (641-675)	A29
Cell proliferation, differentiation, and death, and cancer	3	15	Cooper, Ch. 17 (681-692) Cooper, Ch. 18 (713-723)	A30-31

Learning Methodology

Lectures and homework

Projects and Assignments

None

Evaluation

Evaluation	Point %	Date
Midterm Exam	40%	TBD
Project	0	
Assignments	10%	
Homework	0	
Final Exam	50%	TBD

Main Reference/s:

1. The Cell: A Molecular Approach, Geoffrey M. Cooper and Robert E. Hausmann, 6th edition, Sinauer Associates, 2013.
2. Emrey's Elements of Medical Genetics, Muller & Young, Churchil Livingstone, 13th edition, 2011.

Other References:

1. Molecular Biology, Robert F. Weaver, 2nd edition, McGraw Hill 2002.
2. Genes VII, Benjamin Lewin, edition 1, Oxford Univ. Press, 2000.
3. Medical Genetics, Jorde, Carey, Bamshad, White, Mosby. 4th edition, Mosby, 2009.

Intended Grading Scale

0-39	**F**
45-49	**D$^-$**
50-54	**D**
54-69	**D+**
60-64	**C$^-$**
65-69	**C**
70-73	**C+**
74-76	**B$^-$**
77-80	**B**
81-84	**B+**
85-89	**A$^-$**
90-100	**A**

Notes:

- Concerns or complaints should be expressed in the first instance to the module lecturer; if no resolution is forthcoming, then the issue should be brought to the attention of the module coordinator (for multiple sections) who will take the concerns to the module representative meeting. Thereafter, problems are dealt with by the Department Chair and if still unresolved the Dean and then ultimately the Vice President. For final complaints, there will be a committee to review grading the final exam.
- For more details on University regulations please visit:
  http://www.ju.edu.jo/rules/index.htm