Jordan University of Science and Technology

Faculty of Medicine
2018-2019

COURSE TITLE :	**Molecular Genetics**
COURSE CODE :	**MED 202**
CREDIT HOURS:	**3 CREDIT HOURS**
SEQUENCE :	**YEAR 2, FIRST SEMESTER**
COURSE COORDINATOR:	**Professor Nabil Bashir**
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Course Description:

Molecular Genetics Med 202, 3 credit hours:
Molecular Genetics is a 30-hour course – of which all are devoted to classroom lecture.
Instructional techniques in molecular genetics consist of regular classroom lecture format, twice per week one hour and half each. Laboratory exercises supplement lectures. The course objectives for the molecular genetics course are clearly outlined. The course director and instructors were familiar with the objectives. The course director informs students of the objectives by distributing handouts at the beginning of the course.
The breadth and depth of the course appears to be well balanced, without overwhelming students with more materials than they can handle. This course deals with the basic structure of genes, gene expression, and its regulation, genetic mutations, and polymorphisms. Then, students will be introduced to the basic tools used by molecular biologists to study the above processes. This is followed by studying the principal patterns of cytogenetics, and the uses of cytogenetics in the diagnosis of chromosomal abnormalities. We will also investigate the transmission of genetic diseases in families and in populations. Finally, the cell signaling pathways will be introduced for the student and the genetic/molecular basis of cancer will be discussed. Where appropriate, the course will be supplemented with clinical correlations that have direct relationships with the topic under investigation.
The frequency and method of student evaluation in molecular genetics consist of three written examinations. Written examinations were of the objective type. Average class score on standardized exams ranged from 63% to 68%. The failure rate has ranged consistently between 5 to 10%.
Student evaluation on the molecular genetics course shows a great deal of satisfaction

Course Learning Outcomes

1. Understand the basic structure of nucleic acids.
2. Describe the concepts of DNA replication, recombination, mutations, and repair
3. Describe the concepts of DNA transcription, mRNA translation,
4. Describe the regulation of gene expression and to identify the major molecular tools/techniques used to study genes and analyze their expression.
5. Describe the major cell signaling pathways and to understand the basics of cancer cell biology
6. Recognize Mendalian and non Mendalian inheritance, karyotyping, and chromosomal anomalies

Recommended Textbooks and Atlases:

Book (Resources)
1. Textbook of Biochemistry with Clinical Correlations by Thomas M. Devlin. 7th edition 2. Thompson & Thompson's Genetics in Medicine. 8th Edition. 3. Harper'sIllustrated Biochemistry a LANGE medical book,twenty-sixth edition. Robert K. Murray, Daryl K. Granner, Peter A. Mayes, Victor W. Rodwell.

Learning Objectives

(A) Lectures objectives

Lecture	Title	Objectives
#1 & 2	Purine metabolism:	a. Recognize and contrast the structure of the different purines b. Recognize and contrast the differences between salvage and *de novo* purine synthesis pathways c. Understand the biochemical steps involved in purine synthesis including the name of the enzymes and their regulation. d. Understand the biochemical steps involved in purine degradation e. Recognize how dysregulation of purine metabolism contributes to disease
#3 & 4	Pyrimidine metabolism:	a. Recognize and contrast the structure of the different pyrimidines b. Understand the biochemical steps involved in pyrimidine synthesis including the name of the enzymes and their regulation. c. Understand the biochemical steps involved in pyrimidine degradation d. Understand how purine and pyrimidine

#5	Structure of nucleic acids I	a. Understand the basic structure of nucleotides and how they are organized into nucleic acids b. Understand the experiments that led to the discovery of the DNA structure. c. Understand the structure of the DNA double helix
#6	Structure of nucleic acids II	a. Understand the differences in chromatin structure between prokaryotes and eukaryotes including the role of nucleosomes. b. Differentiate between DNA and RNA structure. c. Differentiate between the structure of the different RNA types including: rRNA, mRNA, tRNA, and mi-RNA
#6	DNA replication I	a. Understand the central dogma of genetics including the basic differences between replication, transcription and translation. b. Understand the importance of DNA replication during cell division. c. Understand the differences between the different models of DNA replication (conservative, semiconservative and dispersive) d. Understand the experiments that led to adopting semiconservative model of DNA replication

#7	DNA replication II	a. Understand the mechanism of DNA replication including the role of all the key proteins and enzymes. b. Differentiate between DNA replication in prokaryotes vs. eukaryotes. c. Understand the function of DNA telomerase
#8	Mutations, DNA repair, and recombination I:	a. Understand the definition of mutations. b. Compare and contrast between the different types of mutations
#9	Mutations, DNA repair, and recombination II:	a. Compare and contrast between the different pathways utilized by cells to repair their DNA including: I. Mismatch repair II. Base excision repair III. Nucleotide excision repair b. describe the recombination and how it does happen
#10 & 11	Transcription in prokaryotes:	a. Understand the process of DNA transcription in prokaryotes including the role of all the key proteins and enzymes. b. Write down the sequence of an RNA molecule based on the sequence of a DNA template.
#12	Transcription in eukaryotes:	a. Understand the process of DNA transcription in eukaryotes including

		the role of all the key proteins and enzymes b. Compare and contrast between DNA transcription in prokaryotes vs. eukaryotes.
#13	RNA processing	a. Understand the importance of RNA processing in establishing genetic diversity in eukaryotes. b. Understand the mechanism and function of 5' capping. c. Understand the mechanism and function of RNA editing. d. Understand the mechanism and function of polyadenylation. e. Understand the mechanism and function of RNA splicing.
#14 & 15	Regulation of gene expression in prokaryotes	a. Understand the structure and regulation of the lac operon. b. Understand the structure and regulation of the tryptophan operon. c. Understand the attenuator model of transcription of the tryptophan operon.
#16	Regulation of transcription in eukaryotes	a. Understand the role of histone acetylation in regulating transcription. b. Understand the structure of eukaryotic promoters and enhancers. c. Study nuclear receptors as an example of regulation of transcription in eukaryotes.

#17 & 18	Translation in prokaryotes	a. Understand the process of protein synthesis in prokaryotes including the role of all the key proteins and enzymes. b. Appreciate the effect of antibiotics on protein synthesis in prokaryotes.
#19	Translation in eukaryotes	a. Understand the process of protein synthesis in eukaryotes including the role of all the key proteins and enzymes. b. Compare and contrast between protein synthesis in prokaryotes vs. eukaryotes.
#20	Protein processing and targeting:	a. Numerate the different types of posttranslational modifications of proteins. b. Understand the meaning of the endomembrane system. c. Understand the sorting mechanism of the different cellular proteins. d. Understand the role of protein ubiquitination in protein degradation
#21	Recombinant DNA techniques:	Understand the details of each of the following techniques: a. Molecular cloning. b. Gel electrophoresis c. Southern, northern and western blotting. d. PCR.

		e. cDNA synthesis. f. Sanger sequencing.
#22& 23	Cell signaling and signal transduction:	a. Compare and contrast between endocrine, paracrine and autocrine signalling. b. Compare and differentiate between cell-surface and nuclear receptors. c. Compare between the different types of cell surface receptors. d. Understand the detailed pathway of GPCR, RAF-MEK-ERK, JAK-STAT, TGFβ-SMAD, and PI3K/AKT signalling
#24 & 25	The Molecular Biology of Cancer	a. Understand the normal cell division cycle b. Understand apoptosis and differentiate between its intrinsic and extrinsic pathways c. Differentiate between oncogene and tumour suppressor genes d. Study cancer cell properties
#26	Inheritance	a. Understand the mendelian rules of inheritance b. Understand each of the following patterns of trait inheritance: i. Autosomal dominant and recessive ii. Sex linked dominant and recessive iii. Codominance and incomplete dominance

		iv. x-inactivation
#27 & 28	Epigenetics & Chromosomal karyotyping	a. Understand how gene expression can be silenced or activated by: i. DNA methylation ii. Histone modification iii. Histone variants b. Understand how chromosomal karyotyping is performed and understand its applications in disease diagnosis c.
#29 & 30	Chromosomal anomalies	Understand the cause and features of each of the following syndromes: a. Down b. Edwards c. Patau d. Klinefelter e. Triple X f. Turner g. Angelman and Pradar-Willi

Course Assessment

Assessment		
Assessment Type	**Expected Due Date**	**Weight**
First Exam		**30**
Second Exam		**30**
Midterm Exam		
Evaluation		
Quizzes		
Research Activity		
OSCE		
Mini-OSCE		
Final Exam (Theory)		**40**
Final Exam (Oral)		
Total		**100**

Students Learning Outcomes

Student Learning Outcomes (SLOs) Upon successful completion of this course, students should be able to:			
SLOs	Related ILQs	Evaluation criteria	
		Type of criteria	Weight (%)
Understand the basic structure of nucleic acids	1,2	MCQ	20
Describe the concepts of DNA replication, recombination, mutations, and repair	1,2,3	MCQ	20
Describe the concepts of DNA transcription, mRNA translation,	1,2	MCQ	20
Describe the regulation of gene expression and to identify the major molecular tools/techniques used to study genes and analyze their expression.	1,2,8	MCQ	15
Describe the major cell signaling pathways and to understand the basics of cancer cell biology	1,2,3	MCQ	10
Recognize mendalian and non mendalian inheritance, karyotyping, and chromosomal anomalies	1,2,3,8	MCQ	15

Intended Learning Outcomes (ILOs)

The aim of this course is to provide basic knowledge of structure and function of nucleic acids in prokaryotic and eukaryotic system. After completing the course the student will be able to:

1. Give an account of the structure and function of nucleic acids
2. Describe the mechanisms for replication, transcription and translation
3. Give an account of mutation, repair and recombination of DNA.
4. Describe some applications of genetic engineering, genomics, and genetic markers
5. allow students and physicians to understand ongoing developments in genetics and to apply them to patient care
6. Acquire the technical language used to communicate molecular genetics information and use that language to describe chromosome structure and function and how genetic information is transferred from one generation to the next, through DNA replication, transcription and translation , Menddelian patterns of inheritance, multifunctional inheritance and its role in human variation and human disease.
7. stimulate thoughts and discussion to encourage analysis and to apply the principles included in molecular genetics to new situations
8. Communicate (through writing and speaking) key concepts relevant to molecular genetics
9. Practice the applications of molecular genetics information in upper level classes.