

MOLECULAR BIOLOGY AND MEDICAL GENETICS (4CH)

(0605315)

1ST SEMESTER, SECOND YEAR MEDICAL STUDENTS

COURSE DESCRIPTION:

This course in your comprehensive human biochemistry education includes an integration of the basics of molecular biology with genetics and basic biochemistry. The course includes detailed description of nucleic acids chemistry, DNA replication and transcription. The mechanisms of gene regulation at different levels will be emphasized. The basics of various mutations in genes will be described along with the various approaches to identify these mutations and their effects. Special mechanisms used by eukaryotic cells to ensure gene diversity will also be described.

This course is designed to guide you in understanding genetics and genomics and their application focusing mainly on the basis principles of inheritance and their impact in human illness in relation to screening, diagnoses, and management of genetic diseases. Definitely, in recent years, there has been enormous changes and advance in clinical genetics and the future promises more breakthrough that will advance our understanding to the role played by genes in our health. However, to interpret all the information now available in the field, it is necessary to understand the basic principles of inheritance and its chromosomal and molecular basis. All medical students, irrespective of their eventual career choice need to be familiar with genetic principles, both scientific and clinical, and to be aware of the ethical implications of genetics technologies that enable manipulation of the genes and their applications in areas like gene therapy, biotechnology and animal and human cloning. Gene therapy strategies and selected applications will be described as a central approach in inherited diseases therapy. This course emphasizes on both theoretical and applied aspects of molecular biology including recombinant DNA technologies, DNA modification, cloning vectors, nucleic acid characterization, PCR and numerous other topics.

AIMS OF THE COURSE:

The main aim of this course is to give the students a firm and rigorous foundation in the principles of modern molecular biology and genetics. These concepts form almost all the basis for the great advances now being made in biology and the medical sciences.



This course aims to provide the students with the knowledge and application of recombinant DNA technology, genetic analysis and genomics.

INTENDED LEARNING OUTCOMES: (ILOs)

A. Knowledge and Understanding

A1. Concepts and Theories:

- Define the science of molecular biology and related topics such as biotechnology
- Describe DNA and RNA structure and their properties
- Understand and explain genome organization in prokaryotes and eukaryotes
- Understand and describe DNA synthesis, their control mechanisms and DNA replication errors
- Understand and describe the processes of transcription and translation, their control mechanism and post-transcription modification
- Differentiate gene expression between prokaryotes and eukaryotes
- Describe the major stages of cell cycle, mitosis, meiosis
- Describe chromosomal abnormalities (numerical and structural) with examples

A2. Contemporary Trends, Problems and Research:

- To understand, and be able to critically analyze, the scientific evidence underlying our current understanding of molecular processes in the cell
- To understand the most recent and modern tools and techniques in molecular biology such as sequencing and PCR, cloning and gene therapy

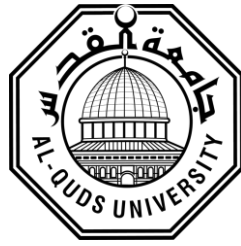
B. Subject-specific skills

B1. Problem solving skills:

- Apply the knowledge from this course to solve problems in scientific research or medical analysis
- Describe scientific procedure for solving problems in identifying and studying different topics related to genetics through analyzing course example for solving pedigree cases and answer questions through the lecture

B2. Modeling and Design:

- To become familiar at formulating hypotheses in related fields of molecular cell biology through analyzing and reading scientific papers in related field



B3. Application of Methods and Tools:

- Understand different methods used in modern molecular biology such as PCR and sequencing and their applications in scientific research and medical analysis

C. Critical-Thinking Skills

C1. Analytic skills:

- To develop a preliminary ability to read and analyze scientific papers in molecular cell biology or other fields that used molecular biology tools and techniques

C2. Strategic Thinking:

- To be able to put the knowledge from this course into larger contexts of how to apply modern molecular techniques in medical laboratory field and the diagnosis of diseases

C3. Creative thinking and innovation:

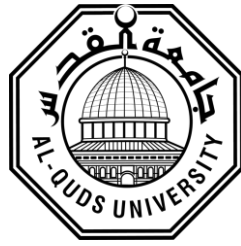
- Use a wide range of idea based on their knowledge in this course to suggest research method related to molecular biology and genetics and apply that on different scientific fields

COURSE OUTLINE:

LECTURE	TOPICS
1+2	Overview of gene expression The central dogma of gene expression, The human genome, Chromosomes and genes, Prokaryotes vs eukaryotes
3	Nucleic acids chemistry Chemical and physical properties of nucleic acids, Denaturation and hybridization, chromosomal elements, DNA supercoiling, Histones, nucleosomes and chromatin structure.
4+5+6	DNA replication Overview and significance, DNA polymerases, The replication fork, The mechanism of the replication process, Fidelity of replication, Replication control, Reverse transcription, Telomeres and telomerase.



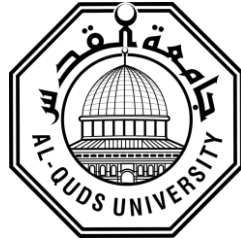
7+8	<p>Somatic mutations and Repair mechanisms</p> <p>DNA damage can lead to mutations, Mechanisms of DNA damage, and Common features of DNA repair pathways e.g. Nucleotide excision repair, Mismatch repair defects. DNA repair defects can lead to cancer.</p>
9+10	<p>DNA recombination</p> <p>Overview of DNA recombination and significance, Mechanisms of DNA recombination, DNA recombination and DNA repair.</p>
11	<p>DNA rearrangement in gene expression</p> <p>General features of protein production by DNA rearrangement e.g. (the immunoglobulin classes).</p>
12+13+14	<p>RNA synthesis and function (Transcription)</p> <p>Types of RNAs in living cells, The complex structure of RNAs, Genes organization in prokaryotes and eukaryotes, , Basic mechanism of transcription, Messenger RNA and the genetic code, RNA processing and modification (splicing, capping and polyadenylation), Stability of RNA molecules.</p>
15+16	<p>Posttranscriptional regulation of gene expression</p> <p>Advantages of post-transcriptional gene control, Alternative splicing, RNA editing, Regulation of RNA stability (regulation of mRNA half-life).</p>
17+18	<p>RNA translation into proteins</p> <p>Aminoacylation of tRNAs, Overview of ribosome structure and function, Translation factors and process (initiation, elongation and termination), genetic code, translation regulation, Antibiotics and translation,</p>
19+20+21	<p>Protein targeting and processing – ER mediated translation and protein trafficking</p> <p>Localization signals direct protein transport, Membrane bound ribosomes, ER and protein entrance to the vesicular transport pathway, The Golgi apparatus and beyond, Fate of misfolded proteins- The role of</p>



	chaperones, Selected abnormalities
22+23	Techniques in Molecular Biology PCR, RT-PCR, sequencing, RFLP, hybridization, DNA foot- printing
24	Midterm Exam = 40 %
25+26	Overview and Development of Genetics. DNA and Chromosomes
27+28	Cell Division (Mitoses, Meiosis and Cell Cycle)
29+30	Mendelian Inheritance. Definition, Patterns of inheritance , (Autosomal Recessive, Autosomal Dominant, X-linked, and nontraditional inheritance)
31+32	Mendelian Inheritance (Pedigree Structure and Symbols)
33+34	Types of Mutations (Gene and Chromosomal). Gene Polymorphisms
35+36	Single Gene Disorders (e.g Thalassaemia, Sickle cell Anemia, and FMF).
37+38	Single Gene Disorders (Huntington, Muscular Dystrophy, Connective Tissue Disorders, Cystic Fibrosis, PKU). Principles of Treatment
39+40	Chromosomal Disorders (Abnormal Chromosome Number)
41+42	Chromosomal Disorders (Abnormal Chromosome Structure)
43+44	Cancer Genetics. Oncogenes and tumor suppressors, Mechanisms of Tumorigenesis, cancer inheritance.
45+46	Cancer Genetics (Colon Cancer, Breast Cancer and Lymphoma)
49+50	Mitochondrial Genetics & Disorders
51	Gene Therapy Applications. Current and future directions
52	Final Exam 60%

TEXTBOOKS:

- 1-Lehninger Principles of Biochemistry
Lehninger, Nelson and Cox (6th Edition) , FREEMAN
- 2- Molecular Cell Biology
Lodish, Berk, Zipursky, Matsudaira, Baltimore, Darnell. FFREEMAN
- 3- Genetics in Practice.
Jo Haydon, John Wiley And Sons, LTD, latest edition
- 4- ABC of Clinical Genetics



Helen M Kingston , latest Edition, BMJ.

RECOMMENDED BOOKS

1- Molecular Biology of the Cell

Albert, Bray, Lewis, Raff, Roberts and Watson (latest Edition)

GARLAND SCIENCE

2- Biochemistry – Chapme, Harvey and Ferrier

LIPPINCOTT, WILLIAMS & WILKIN, latest edition.

3- Genetics in Medicine

Thompson & Thompson, latest Edition

EVALUATION:

Exam	Grade	Date
Midterm	40%	To be confirmed by faculty & registration office
Final Exam	60%	To be confirmed by faculty & registration office