

**MASTER OF SCIENCE  
MOLECULAR BIOLOGY  
[JOINT DEGREE PROGRAM]**

**Program code: 2050**

***INTRODUCTION***

The Colleges of Medicine and Science offer a joint Master's degree program in **Molecular Biology**. The major aim of the program is to prepare future academicians and researchers in the field of Molecular Medicine, Molecular Biology and Biotechnology. It is expected that the graduates of this program will be competent enough to deal with the future challenges in the area of Molecular Biology and Biotechnology, and their applications to the future needs of Kuwait. The program features only a thesis option.

*According to the University Council decision dated 4/2/2007, Thesis students admitted with effect from September 2007 are exempted from the comprehensive examination.*

***PROGRAM REQUIREMENTS***

**32 TOTAL COURSE CREDITS**

**14 COMPULSORY (credits in parenthesis)**

2050-504	Techniques in Molecular Biology	(3)
2050-506	Advanced Molecular Biology	(3)
2050-507	Advanced Cell Biology	(3)
0510-501	Biostatistics and Computer in Medicine	(2)
2000-501	Scientific Writing and Communication Skills	(3)

**9 ELECTIVE COURSES\* (3 credits each)**

2050-509	Genetics of Complex Diseases
2050-512	Molecular Medicine
2050-514	Molecular Microbiology
2050-516	Molecular Diagnosis of Infectious Diseases
2050-526	Advanced Biotechnology

\*The student is allowed to study 3 credit hours of graduate courses from different disciplines from the faculty of medical sciences, or the College of Science, or 3 credits from a 400 level course offered by the Molecular Biology program with the approval of the academic supervisor and program director.

**9 COMPULSORY**

2050-597 Thesis (0)

2050-598 Thesis (0)

2000-599 Thesis (9)

The student's thesis is based on research in the major field of specialization.

**COURSE DESCRIPTION****2050-504: TECHNIQUES IN MOLECULAR BIOLOGY****CR: 3**

This course is practical based and will cover important basic techniques such as: Lab safety and preparation of solutions; Buffers and media; Isolation and analysis of nucleic acids; DNA amplification and gel electrophoresis. Students will be trained on current molecular techniques for special applications such as: Gene expression profiling, SNP detection, sequencing, cloning and transformation and genomics. Techniques will include the use of the latest instruments such as Realtime PCR, microarray, sequencing and bioinformatics. The course will involve lab rotations with a final presentation of a short project for the student evaluation.

**2050-506: ADVANCED MOLECULAR BIOLOGY****CR: 3**

Structures of biological macromolecules, DNA as the genetic material, RNA synthesis and processing, protein structure and function. Emphasis is placed on genomes and genome structure, chromosome organization, the process of DNA replication in eukaryotes and prokaryotes, mutation and injury to DNA; DNA repair and recombination. The course will also give insight into the approaches and methodologies of molecular biology used to study the organization, expression and regulation of genes by covering recombinant DNA cloning methods; the isolation, manipulation and molecular characterization of DNA, in vivo genetic analysis in selected prokaryotic and eukaryotic organisms. Analysis of important biological functions by using mutagenesis and genetic mapping in model organisms will also be covered.

**2050-507: ADVANCED CELL BIOLOGY****CR: 3**

This course is designed to provide students with an appreciation of molecular principles to conceptualize cell functions and behaviors. Emphasis will be placed on (a) molecular basis of cell architecture, extracellular matrix, and cell adhesion; (b) nucleus the cell commanding center, and molecular strategies of the cell to function, survive, and communicate with other cells, through protein targeting, intracellular trafficking of essential materials, and signal transduction; (c) molecular aspects of cell history from stem cells, differentiation and cell cycle, to cell aging and death pathways. The overall goal is to educate and train students to be able to integrate modern theories of cell biology and molecular biology into an innovative perception of 'molecular cell biology' as an entity, through critical thinking and discussions. Students' learning will be further strengthened by practical training in advanced techniques which are essential for them to pursue further advancement in an area of molecular and cell biology.

**2050-509: GENETICS OF COMPLEX DISEASES****CR: 3**

This course will introduce what is a genetic complex disease by selecting one or two models (e.g. Obesity as a case study). It will describe the pathogenesis with emphasis on the molecular mechanisms of a selected complex disease. The course will then focus on covering the heritability of the disease, studying the genes associated with the disease from knock-out studies to candidate gene studies, to genome-wide association studies. Investigating the genes identified from GWAS in disease pathogenicity and susceptibility. Molecular

screening and diagnostic methods will also be reviewed for the selected diseases.

**2050-512: MOLECULAR MEDICINE**

**CR: 3**

The objective of this course is to present/discuss/appreciate an inter-disciplinary approach to the study and treatment/management of human disease. We have selected four different areas to use as examples - cancer, cardiovascular and haematological disease, autoimmune disease and neurodegenerative disease in addition to which there will be a section on drug delivery. The aim will be to introduce some basic information/concepts/hypotheses and then illustrate an integrated view of particular diseases from various points of view; clinical, morphological and molecular. As needed additional relevant data/concepts will be referred to in the context of the disease. It is hoped to stimulate an understanding of how basic science and clinical medicine can come together and to illustrate the various ways in which we can examine the molecular basis of disease, to provide opportunities for therapeutic intervention and eventually cure and prevent.

**2050-514: MOLECULAR MICROBIOLOGY**

**CR: 3**

This course will cover topics such as: Microbial systematics, microbes' species concept, various molecular approaches used to classify and phylogenetically investigate prokaryotic and eukaryotic microbes as well as viruses. The omics and meta-omics approaches, their role in investigating the structural and functional diversity of microbes, in particular the uncultured microbes from various environmental samples. Meta-genomics, -transcriptomics, -proteomics, -bolomics, cytomics and single cell analysis: definitions, importance, applications and limitations. Case studies applying various metaomics approaches will also be discussed. Synthetic microbiology: synthetic microbial cells and synthetic microbial consortia and their biotechnological applications will be covered.

**2050-516: MOLECULAR DIAGNOSIS OF INFECTIOUS DISEASES**

**CR: 3**

Basic principles of molecular diagnostics of infectious diseases, major methodologies used in molecular diagnostics of infectious diseases and for discovery of novel microbial pathogens. Major molecular diagnostics tests used in clinical practice such as nucleic acid sequencing and its diagnostics applications; gene arrays will be discussed.

**2050-526: ADVANCED BIOTECHNOLOGY**

**CR: 3**

Techniques in biotechnology and their applications. The course will deal with two major aspects: Plant Biotechnology and Animal Biotechnology. Topics in plant biotechnology will include Genetic Engineering of plants to overcome biotic and abiotic stress. Biotechnology plant Quality and proteins will be reviewed and discussed. Recent topics in animal biotechnology will be reviewed including the use of transgenic animals, molecular diagnostics, protein therapeutics, nucleic acids as therapeutic agents and vaccines, Human cell therapy and stem cell research. Regulation and patenting of molecular biotechnology will also be discussed.

**2050-597: THESIS**

**CR: 0**

**2050-598: THESIS**

**CR: 0**

**2000-599: THESIS**

**CR: 9**