Master of Science in Biological and Biomedical Sciences

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A graduate program in applied areas of biological and biomedical sciences.

Qatar is facing a number of unique challenges in the healthcare sector. There is a continuous progress in the treatment of diseases such as diabetes, cancer, cardiovascular diseases and mental disorders in Qatar and across the region. While these diseases seem to be incoherent, modern discoveries prove clearly that the wide prevalence of such diseases in many regions of the wor general and Qatar in particular is due to a combination of causes related to environmental pollution and genetic factors. High rates of endogamy in Qatar and the Gulf region lead to genetic mutations that cause or exacerbate such diseases. However, molecular and cellular mechanisms related to such diseases remain embarrassing.

In order to encounter some of these challenges, the graduate programs in the biological and biomedical sciences aim to train the next generation of scientists and encourage the best and most distinguished students to pursue the leading positions in biomedical research field in Q.

Outline for the BBS MS program

Year 1	Semester 1	Core Classes		
	Semester 2	Core and Elective Classes	BEGIN THESIS RESEARCH	
				RAC meeting
Year 2	Semester 3	Elective Classes	THESIS RESEARCH	
	Semester 4	THESIS RESEARCH		RAC meeting
		SUBMIT AND DEFEND MS THESIS		

Students spend the first semester taking core classes while identifying potential research advisors. In the second semester, students take a mix of core and elective classes. At this time, students begin their thesis research, and get a Research Advisory Committee (RAC) formed; a committee that will give advice and oversee the student's progress. At the end of the two years, all MS students are anticipated to submit a written thesis and defend it orally.

Train the next generation of scientists in their fields with world-class expertise in cutting-edge technologies in biologically and bio-medically relevant areas, to be able to translate research findings into clinical benefits.

> Train the next generation of scientists that are leaders in their fields with world-class expertise in cutting-edge technologies in biomedically relevant areas of biology able to translate research findings intoclinical benefits.

Curriculum

A 33-credit program, taught in English over two years, that includes:

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4 Core Courses

A list of BBS Core courses:

LS 501 Research Methods and Ethics

This course is a foundational course for graduate students who will be engaged in research. It provides students with an introduction to ethics and ethical misconduct, intellectual property and environmental health and safety as well as scientific thought and design of experiments. A focus of the course is to transition students from textbooks to primary literature as their main source of information.

CSE 502 Statistics for Science and Engineering

This is an introductory course on probability theory and statistics, which will cover fundamental principles of statistics and their applications in science and engineering.

Course topics will include:

1. Basic probability theory
2. Random variables and probability distributions
3. Hypothesis testing
4. Analysis of variance
5. Regression
6. Design and analysis of experiments, and other relevant topics.

LS 503 Advanced Molecular Biology

This course covers the important principles in Molecular Biology, including the replication of DNA, how DNA is converted to RNA, how RNA is modified, transported and regulated, and finally how it is converted to protein. Through the use of primary literature papers, students will gain a current understanding of these subjects.

LS 505 Advanced Cell Biology

This course builds on the knowledge students acquired in Advanced Molecular Biology and covers the important principles of Cell Biology, the study of the basic unit of life. By relying heavily on recently published, seminal scientific papers, students will acquire an accurate understanding of the current research progress in key areas in cell biology.

4 elective courses:

A representative list of BBS elective courses:

LS 600 Techniques in Biochemistry

This course is designed to train students in a range of standard biochemical and cellular biology techniques that are in routine use in a functioning biochemistry laboratory. The course combines lectures illustrating the scientific principles underlying a particular technique with hands-on experience of the methodology in the laboratory. Techniques include protein expression, purification, gel analysis, protein structure and cell culture.

LS 609 Molecular and Cellular Biology of Neurodegenerative Diseases

This course will engage students in a detailed exploration of the most important neurological disorders, including Alzheimer's disease (AD), Parkinson's disease (PD), Huntington's disease (HD) and prion diseases. With an initial focus on clinical descriptions for each condition, an indepth discussion on current hypotheses about the mechanisms underlying these diseases will constitute the bulk of this course.

LS 610 Cancer Biology

In this course, students will be exposed to the latest findings in the molecular mechanisms that underlie the genesis and progression of human cancers. Lectures and discussions will be based entirely upon the current scientific literature. These papers will highlight how perturbation of the cell cycle, DNA damage checkpoints, and repair machinery can both promote cancer and be capitalized upon for cancer treatment.

LS 620 Bioinformatics

This is an introductory course for bioinformatics, whose main goal is to provide an in-depth introduction to several probabilistic and statistical models as well as algorithms and techniques that are widely used in bioinformatics, especially, for the analysis of biological sequences.

Course topics will include:

1. Sequence alignment techniques
2. Markov chains and hidden Markov models (HMMs)
3. Transformational grammars
4. Stochastic context-free grammars (SCFGs)
5. RNA folding and alignment
6. Other emerging topics in bioinformatics

LS 640 Stem Cell Biology

This course is intended as an introduction and in-depth discussion focused on the biology of stem cells. The course will introduce the features of stem cells and basic mechanisms regulating their self-renewal and pluripotency. In addition, the course will focus on selected examples of adult stem cells with an introduction to translational medicine approaches involving stem cell biology.

Major emphasis will be placed on how advances in stem cell biology and tissue engineering can be applied to the use of embryonic and adult stem cells in regenerative medicine. In addition to these topics, students will be introduced to the ethical, regulatory, and legal issues related to stem cell research.

LS 651 Principles of Cellular and Molecular Immunology

The field of immunology has witnessed a huge surge in knowledge in the last 40 years. From relatively modest and rather esoteric beginnings, immunology has become one of the most dynamic and exciting areas of medical sciences. This course encompasses the major sub- disciplines in the field. These will include, but not be limited to, development and maturation of the various cell lineages of the immune system, phylogeny and structure-function relationship of cell-associated as well as soluble receptors used by the immune system, the mechanisms of antigen processing, presentation, and recognition, properties of innate vs. adaptive immune responses, communication and cell-cell interactions, immunoregulation, and humoral and cellular effector mechanisms.

LS 653 Environmental Microbiology

This course provides students with knowledge in microbial communities and their distribution in the environment; microbial pathogens and their transmission pathways in water, air, soil and food; and the various sources of microbial contamination in the environmental. This course also covers environmental applications of molecular technology and other advanced detection tools. Furthermore, emerging issues, such as health implications of nanotechnology, renewable energy, climate change and infectious disease, urban microbiology, and food safety will be discussed to give insight to future environmental health concerns.

LS 606 - Molecular Biology of Neuroscience

This course is intended for graduate students interested in gaining a detailed understanding of molecular mechanisms underlying synaptic function and development. Throughout the course, the focus will be on understanding the experimental approaches that produced current knowledge. In most weeks, students will be assigned recent research papers as their primary reading material. About 2/3 of the classes will be lectures by the instructor and 1/3 will be student led discussions of papers.

LS 633 - Epigenetics

The aim of the course is to provide an introduction to epigenetics and chromatin dynamics, particularly the structural and biochemical modifications of chromatin that underlie epigenetic states and their effects on gene expression and human diseases. The importance of epigenetic states is perhaps the major discovery of molecular biology in the past ten years. They are critical to understanding the control of gene expression in development, the programming and reprogramming that takes place in the differentiation of pluripotent stem cells and they provide an accounting for many of the genomic malfunctions that result in human disease. An acquaintance with the concepts of what has come to be known as Epigenomics is essential for a Molecular Biology major.

LS 706 Independent Study

Independent Study in Life Sciences allows students to examine a variety of timely, cutting-edge research areas. Taught by our faculty or/and research scientists from our research institutes or industrials, this course allows students to keep up with critical trends and topics in the field. Registration for this course requires Program Coordinator and Instructor approval. In addition, a student can only register for this course once during their tenure at HBKU.

LS 661 Special Topics in Biosensors

This course provides a comprehensive, bottom-up coverage of how biosensors are engineered starting from physical transduction and electrical detection all the way to signal conditioning and processing. The course is structured around sensing principles including physical phenomenon as well as electronics (VLSI circuits) of the different sensory systems and processing of biosensing signals.

YOU MAY WANT TO CHECK

Research

Research is integral to Hamad Bin Khalifa University’s mission to help build human capacity in Qatar, playing a pivotal role in HBKU’s academic programs across all its colleges.

- Qatar Environment and Energy Research Institute (QEERI)
- Qatar Biomedical Research Institute (QBRI)