

M.Phil. Molecular Biology



MASTER OF PHILOSOPHY IN MOLECULAR BIOLOGY (MPHIL MOLECULAR BIOLOGY)

PROGRAMME STRUCTURE

YEAR 1

SEMESTER 1

<i>CORE</i>		CREDITS
BCMB 601	Complex Biomolecules	2
BCMB 603	Advanced Molecular Biology	3
BCMB 607	Molecular Mechanisms of Development	2
BCMB 609	Immune Response Mechanisms	3
BCMB 610	Special Topics	1
BCMB 620	Experimental Techniques	3
<i>ELECTIVES Select a minimum of 2 credits</i>		
BCMB 605	Advanced Protein Chemistry	2
BCMB 611	Pesticide Biochemistry	2
BCMB 613	Parasite Biochemistry & Antimicrobial Chemotherapy	3
TOTAL		16

SEMESTER 2

<i>CORE</i>		
BCMB 604	Bioinformatics	3
BCMB 612	Applications of Biotechnology	3
BCMB 614	Eukaryotic Cell Biology	2
BCMB 630	Research Methodology & Scientific Communication	3
<i>ELECTIVES Select a minimum of 3 credits</i>		
BCMB 602	Advanced Enzymology	2
BCMB 606	Mitochondrial Biochemistry	2
BCMB 608	Signal Transduction	3
BCMB 616	Biochemical Toxicology	2
BCMB 618	Secondary Metabolism & Natural Products	3
TOTAL		14

YEAR 2

<i>CORE</i>		
BCMB 600	Thesis	30

SEMINARS

BCMB 640	Seminar I	3
BCMB 660	Seminar II	3

BCMB 601
COMPLEX BIOMOLECULES

This course deals with advanced topics in carbohydrate chemistry, carbohydrate disorders, lipid chemistry, glycolipid structure in the context of cellular processes and disease states; lipid disorders and N- and O-glycans- key post-translational modifications of proteins. The course will also cover recent advances in carbohydrate, protein and lipid research.

BCMB 602
ADVANCED ENZYMOLOGY

This course covers topics such as mechanisms of enzyme action; steady state and pre-steady state enzyme kinetics; fast reactions and industrial production and applications of enzyme. Recent advances in enzymology research will also be discussed with emphasis on the role of enzymes in diagnosis.

BCMB 603
ADVANCED MOLECULAR BIOLOGY

This course focuses on the study of life using techniques that reveal the molecular make-up of organisms. The major topics will include: key tools for cloning, gene identification and DNA libraries, sequencing, PCR; production of proteins from cloned genes and application of recombinant DNA technology in Agriculture, medicine and Industry will also be discussed. The course will however, begin with general review of structure and function of nucleic acids - DNA, RNA; basic cell biology of prokaryotes and eukaryotes; molecular nature of genes, plasmids, bacteriophages, cosmids, viruses and artificial chromosomes.

BCMB 604
BIOINFORMATICS

This course is a newly developing area of science that uses computational approaches to answer biological questions. It involves searching biological databases, comparing sequences, looking at protein structures and asking biological and biomedical questions with a computer. Bioinformatics is rapidly changing the fundamental way of basic science by preventing months of work in the laboratory at the minute cost of a few hours' work behind the computer and planning a better experimental design.

BCMB 605
ADVANCED PROTEIN CHEMISTRY

The goal of this course is to expose students to advanced topics in protein chemistry. Major topics such as physical properties of proteins, separation techniques, protein structure and stability, post-translational modifications, protein structure prediction and recent advances in protein chemistry research will be discussed. Additionally, Proteomics as a research tool to advance better understanding of cellular function will be introduced.

BCMB 606
MITOCHONDRIAL BIOCHEMISTRY

This course is designed to equip students with advanced bioenergetics background. The main objective is to give students insights into the role of mitochondria in health and diseases. The major topics to be covered are: mitochondrial biogenesis and oxidative phosphorylation, uncoupling

proteins, role of mitochondria in growth and development, mitochondria and cellular signalling, role of mitochondria in stress and diseases, mitochondria and drug development and mitochondrial DNA inheritance.

BCMB 607
MOLECULAR MECHANISMS OF DEVELOPMENT

In this course, a number of model organisms will be used as the context within which to discuss the fundamental processes that lead to the generation of a whole organism from a single cell zygote. The activation and sequence of molecular events and the mechanism of their regulation in time and space leading to the formation of individual tissues, organs and systems will be covered in great detail. Many cell-cell signalling pathways are required to differentiate and form the various tissues of an organism. This course provides students with an in-depth understanding of molecular biology; molecular mechanisms involved in embryo development are similar to that of the process of disease and tissue regeneration.

BCMB 608
SIGNAL TRANSDUCTION

This is an advanced course on cell signaling designed to give students insights into the underlying molecular mechanisms and current trends in signal transduction research. The format includes lectures, presentations of original literature by students, and discussions of selected papers with emphasis on experimental approaches and results. Major topics covered include: Types of signaling

molecules; Cell Surface and nuclear receptors; Monomeric and heterotrimeric guanine nucleotide binding proteins; Effectors and regulators of receptor tyrosine kinase signaling pathways, G-protein coupled receptor signaling; Cytokine receptor signaling; Signaling through ion channels; Receptor transactivation and Crosstalk.

BCMB 609 **IMMUNE RESPONSE MECHANISMS**

This course is an advanced study of Immunology and takes a detailed look at the molecular mechanisms through which the immune system responds to pathogens. A major goal of the course is to prepare students for research in the fields of Immunology, disease pathogenesis and vaccine development. The content includes discussions of the mechanisms of antigen processing and presentation, T-cell and B-cell receptor gene rearrangements, recombination of VDJ gene segments, affinity maturation and somatic hypermutation. Current advances in immunological methods such as flow cytometry, and new developments in the search for vaccines for malaria and HIV will also be discussed.

BCMB 610 **SPECIAL TOPICS**

Students will be taken through full grant proposal writing and required to submit proposals in topics to be specified.

BCMB 611 **PESTICIDE BIOCHEMISTRY**

This course designed to acquaint students with the chemistry, biological activities and mechanisms of action and environmental impact of pesticides. History and classes of pesticides; natural products as leads for development of pesticides; molecular basis of pesticide action; biochemical processes for metabolizing and eliminating pesticides; biochemistry of pesticide resistance; and impact of pesticide use on human health, as well as the environment. Students acquire skills that enable them appreciate processes involved in pesticide development and pesticide action and advise on precautionary measures in pesticide use and assist with monitoring pesticide resistance in organisms such as insects and pesticide residues in food and the environment.

BCMB 612 **APPLICATIONS OF BIOTECHNOLOGY**

Biotechnology deals with the application of living organisms, biological systems and processes or their derivatives to manufacture or modify a product and to render a service. The course combines knowledge from Biochemistry, Molecular Biology and Genetics, Microbiology, Cell Biology and links up with specialized areas in Chemical Engineering, which is Biochemical/Bioprocess Engineering. The advances in DNA recombinant techniques as well as the sequencing of the Human genome and that of several other organisms have lead to the expansion of opportunities in biotechnology. The course will expose students to the advantage of bioprocesses over the traditional methods

of manufacturing such low energy demand and limited environmental impact.

BCMB 613 **PARASITE BIOCHEMISTRY & ANTIMICROBIAL CHEMOTHERAPY**

This course is designed to equip students to better understand the mode of life of most of the disease-causing parasites in the tropics and to explore the biochemistry of the causative parasites in the design of chemotherapeutic agents. Special emphasis is placed on the evasive mechanisms of parasites including the development of drug resistance, host defence mechanisms and the principles of selective toxicity. The diseases covered in this course include malaria, onchocerciasis, schistosomiasis, trypanosomiasis/ leishmaniasis, filariasis and buruli ulcer. The course will also cover recent advances in understanding the biochemistry of parasites using current publications.

BCMB 614 **EUKARYOTIC CELL BIOLOGY**

This course focuses on membrane systems, organelles, the cell surface, cytoskeleton and extracellular matrix aspects of protozoan and some specialized higher eukaryotic cells. The ultra cellular structures common to all the cell types of interest as well as the key features unique to all the cell types will be described in detail. Specialized organelles used by parasitic protozoan will also be discussed in the context of their role in pathogenesis and the interaction with host cell structures. The course will also cover cellular processes and the dysfunctions that cause disease.

BCMB 616

BIOCHEMICAL TOXICOLOGY

The course covers fundamentals of xenobiotic metabolism including pathways and enzymology of metabolism and the factors affecting metabolism. It also features the types and mechanisms of toxicity as well as target organ toxicity using specific examples of xenobiotics as agents of toxicity in various organs. It includes the assessment of organ specific toxicity involving pathobiological, haematological, biochemical and enzyme activity studies.

BCMB 618

SECONDARY METABOLISM & NATURAL PRODUCTS

This course is designed to equip students with the requisite knowledge to better understand the processes involved in the production of biologically important secondary metabolites. The course discusses secondary metabolism in plants, fungi and soil bacteria (actinomycetes). The course will also familiarise students with the great diversity of secondary metabolites produced naturally by plants, animals, fungi and soil bacteria

BCMB 620

EXPERIMENTAL TECHNIQUES

This course covers practical skills in molecular biology and biochemistry. The molecular biology and the biochemistry components will be run separately, and students will be required to take only one option depending on their major.



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BCMB 630:

RESEARCH METHODOLOGY AND SCIENTIFIC COMMUNICATION

Students will be taken through various topics in research methodology and scientific communication. The major topics to be discussed are: elements of scientific project planning; research design and statistical analysis; laboratory quality assurance; standards for quality research; initial considerations; scientific and technical presentation; professional conduct.

BCMB 640

SEMINAR I

This is a journal club where each student would be required to review and make presentations on good biochemistry, cell or molecular biology research article from a reputable journal. In addition, each student will be required to attend all departmental seminars.

BCMB 660

SEMINAR II

Each student will make presentations on his/her thesis research proposal and progress report. In addition each student will be required to attend all departmental seminars.

BCMB 600

THESIS

Each student will undertake a major research project and present a written dissertation. In addition, students will present an oral defence of their thesis.