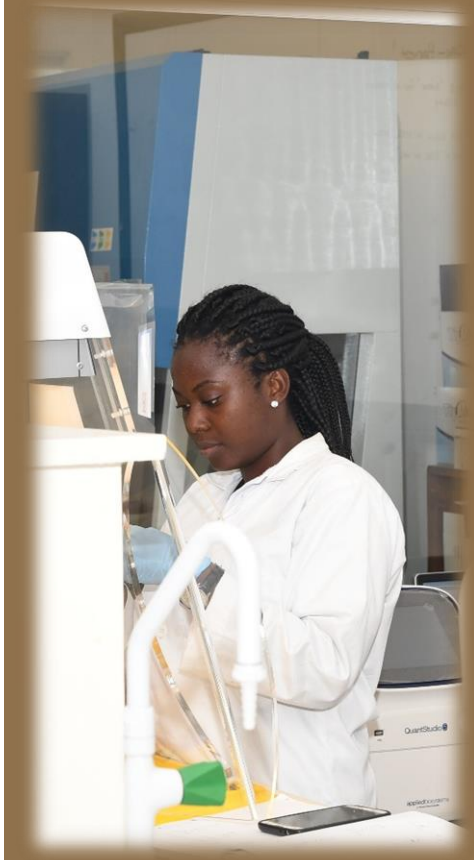
M.Phil. Molecular Cell Biology of Infectious Diseases



MASTER OF PHILOSOPHY IN MOLECULAR CELL BIOLOGY OF INFECTIOUS DISEASES (MPHIL MCBI)

PROGRAMME STRUCTURE

YEAR 1

SEMESTER 1

CORE		CREDITS
MCBI 601:	Bacterial and Viral Infections	3
MCBI 603:	Experimental Microbiology	3
BCMB 603:	Advanced Molecular Biology	3
BCMB 609:	Immune Response Mechanisms	3
BCMB 630:	Research Methodology & Scientific Communication	3
TOTAL		15

ELECTIVES ***Select maximum of 3 credits***

BCMB 605:	Advanced Protein Chemistry	3
BSTT 601:	Methods in Biostatistics I	3

SEMESTER 2

CORE

MCBI 602:	Eukaryotic Infections: Protozoan, Helminthic and Fungal	3
MCBI 604:	Host and Pathogen Genomics	3
MCBI 606:	Antimicrobial Therapeutics: Molecular Mechanisms and Concepts	3
MCBI 608:	Molecular Epidemiology of Infectious Diseases	3
MCBI 610:	Seminar I	3
TOTAL		12

ELECTIVES ***Select 3-6 credits***

BCMB 608:	Signal Transduction	3
BCMB 612:	Applications of Biotechnology	3
BCMB 614:	Eukaryotic Cell Biology	2
ENTO 606:	Disease Vectors of Medical and Veterinary Importance	3
BSTT 602:	Methods in Biostatistics II	3

YEAR 2

CORE

MCBI 600:	Thesis	30
MCBI 620:	Seminar II	3

BCMB 603

ADVANCED MOLECULAR BIOLOGY

This course focuses on the study of life using techniques that reveal the molecular make-up of organisms. A 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 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 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 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 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 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.

BSTT 601
METHODS IN BIOSTATISTICS I

This module introduces the basic statistical concepts and methods as applied to diverse problems in public health. Students should be familiar with data handling commands in Stata. Topics to be covered are: an introduction to classical inference including the distinctions between population and sample, and between statistics and population values, and types of data. This component will also include analysis of continuous data (including linear regression), analysis of binary data, and analysis of count data within the concept of sampling distributions, estimation, confidence intervals, hypothesis tests, types I and II errors. Also included is the comparison of groups, association (contingency tables), stratification (Mantel-Haenzel methods) and interaction.

BSTT 602
METHODS IN BIOSTATISTICS II

This module describes the logistic function, the popularity of the logistic model, and how the model may be applied in epidemiology. Several important special cases of the logistic model involving dichotomous exposure variable are considered with their corresponding odds ratio expressions. In particular focus, is a simple analysis of a fourfold table, and assessment of multiplicative interaction between two dichotomous variables. Models that account for the potential confounding effects and potential interaction effects of covariates are emphasized. It also describes the general maximum likelihood procedure in estimating the regression parameters. It discusses how to make statistical inferences using maximum likelihood (ML) estimates.

ENTO 606
DISEASE VECTORS OF MEDICAL AND VETERINARY IMPORTANCE

Arthropod vectors of disease; taxonomy, biology, and incrimination of vector capacity, ecology of vectors, epidemiology of vector-borne diseases, parasites transmitted by insect vectors, life cycle and symptomatology of diseases; animal reservoirs, vector control methods as applied to blackfly, tsetsefly, mosquitoes, ticks and mites. Emerging disease vectors of medical and veterinary importance.

MCBI 601
BACTERIAL AND VIRAL INFECTIONS

This course aims to provide insight on bacterial and viral infections that are major public health concerns in sub-Saharan Africa. Aspects to be discussed will include the biology of the pathogen, the pathogenesis of its infection, the pathophysiology of the human host, and current strategies for therapeutics and vaccinology. The molecular mechanism of each pathogen will be discussed, thereby elucidating the pathways for disease progression and pathogen success. Treatment of each pathogen will be organized in two complementary formats; the first based on the major classes of pathogens, and the second grouped according to the primary site of pathogenesis within the human host.

MCBI 602
EUKARYOTIC INFECTIONS: PROTOZOAN, HELMINTHIC AND FUNGAL

This course will aim to teach the biology of eukaryotic pathogens with an emphasis on the molecular mechanisms underlying pathogen success. Treatments will elucidate diseases caused by both protozoan parasites (e.g., *Plasmodia*, Trypanosomes, *Leishmania*, and *Toxoplasma*) and selected pathogenic fungi and helminths. The uniqueness of each host-pathogen interaction will be developed, including pathways for infection and host cell invasion, host pathophysiology, and the survival strategies by each pathogen (e.g., immune evasion by antigenic variation). Modern efforts at vaccine development and the identification of new drug targets will be discussed, as well as the resistance mechanisms by these pathogens.

MCBI 603
EXPERIMENTAL MICROBIOLOGY

This laboratory course aims at providing practical training and experience in the methods and practices necessary for a successful career in microbiology. Work will include: growth and characterization of various microbial organisms that are representative of important pathogens; methods to visualize cell specialization, such as light microscopy and the analysis of cell fluorescence; extraction and characterization of proteins and nucleic acids from cells; the infection of cells by viruses; and the methods used to characterize virus life-styles. Methods learned in this course will include sterile technique for handling pathogens, advanced light microscopy, operation of numerous instruments as well as separation methods.

MCBI 604

HOST AND PATHOGEN GENOMICS

This course aims to introduce students to the principles and tools for genomic and proteomic study of host-pathogen interactions. To that end it will discuss the content of multiple genomes elucidating their functions and organization. The course will also develop the modern, computer-based subjects of transcriptomics/metabolomics and the functional genomics of bacterial, viral and eukaryotic pathogens. Classical and complex disease genetics and quantitative trait locus (QTL) analysis, natural selection of pathogens, comparative genomics, genome wide association studies, genetic manipulations, computational learning (genome databases, modern methods for DNA sequencing, assembling pathogen genome sequences, genome-wide sequence read mapping and variant calling) will be discussed.

MCBI 606

ANTIMICROBIAL THERAPEUTICS: MOLECULAR MECHANISMS AND CONCEPTS

This course is aimed at teaching concepts in drug discovery and development. Various types of drugs will be characterized: agonist/antagonists, biologics, protein/non-protein drugs, small molecule drugs. Where possible, their mechanisms will be described: inhibitors of bacterial cell wall biosynthesis, inhibitors of nucleic acids, inhibitors of metabolism, anti-mycobacterials agents, antiviral agents, antiparasitic agents, anti-helminthes, microbiocides. Recent work on novel therapeutic approaches and delivery methods, on drug recycling, host process targeting, and the use of modified peptides will be described. The course will also cover the complexities of antimicrobial therapy. Finally, we will examine mechanisms of resistance to antimicrobials, the biosynthesis of antimicrobials, ending with an overview of commercial drug development and the phases of clinical trials.

MCBI 608

MOLECULAR EPIDEMIOLOGY OF INFECTIOUS DISEASES

The course aims to teach the principles and practical approaches for the use of molecular laboratory techniques to address problems in the epidemiology of infectious diseases. These will include the use of molecular techniques in investigations of disease outbreaks, the characterization of disease transmission dynamics, and identifying risk factors for transmission. Epidemiological study designs such as case-control, cohort and cross-sectional studies will be introduced and analysis of molecular or genetic data obtained from these studies. The course will also discuss molecular methods for identifying antimicrobial resistance and for determining the population structure of pathogens using genetics. Students will also be introduced to on-line tools and databases such as Sit-vit, and MIRU-VNTR plus for determining circulating strains.

MCBI 610

SEMINAR I: PROPOSAL SEMINAR

Students will be required to present their research proposal and attend all departmental seminars. Each student will also review and present a selected recently published research article each semester. These presentations will be attended by all graduate students and graded by all faculty members. In addition, students will be assigned into small groups (five or less) for more interactive journal clubs led by a faculty member, where they will review and critique recent seminal articles in a relevant field.

MCBI 620

SEMINAR II: PROGRESS REPORT SEMINAR

Each student will deliver a presentation on the progress of his/her research work each semester. In addition, each student will be required to attend all departmental seminars.

WACCBIP

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