Curriculum of M. Phil Program

in

Molecular Cell Biology and Genetics

2007

King Edward Medical University, Lahore – Pakistan

FOREWORD

One of the greatest conceptual achievements in 20th century biological sciences was discovering “the molecular logic of the living state”.....how a molecule’s function arises from its structure, and realizing how information is conveyed to the rest of the cellular machinery. This is at the core of molecular and cell biology and modern biotechnology and has had a profound impact on the practice of contemporary medicine.

Biomedical sciences are progressing at an unprecedented rate, new and innovative therapies are being devised at molecular and cellular level for conditions that had poor prognosis or were considered untreatable by traditional medicine. Gene therapy, RNAi (gene silencing), nano biotechnology (engineering of small molecule for therapeutic use) and stem cell therapy for example are on the horizon and it may not be long before these techniques become main staple of the therapeutic medicine. Also Molecular Biology has had a major impact on clinical diagnostics and is likely to further transform the field in the next decade. Polymerase Chain Reaction (PCR) based diagnostics for example has already taken a strong foothold in diagnosis of several genetic and pathogenic disorders.

A comprehensive understanding of the cell function and effects of therapeutic reagents at the molecular level would significantly improve physician’s understanding of “cause and effect” consequently improving their ability to effectively treat their patients. Therefore King Edward Medical University has taken on the critical task of educating the next generation of medical practitioners in molecular and cellular biosciences so have a clear and comprehensive understanding of modern biomedical sciences and are able to provide the best possible care to the patients.

Prof. Dr. Fridoon Jawad Ahmad
HEC Foreign Professor
Director M. Phil Program
Clinical Molecular Cell Biology and Genetics

Introduction

King Edward Medical University (KEMU) is committed to excellence in promoting biomedical education at all levels and has robust programs at both undergraduate and postgraduate levels. KEMU has the distinction of being the first medical institute in the country to offer an M.Phil program in Molecular Cell Biology and Genetics. KEMU has philosophy of not only enhancing the depth of knowledge of its students but also the breadth. Therefore during the first semester students will be required to take some multidisciplinary classes, which are compulsory for all M.Phil Students regardless of their area of specialization. Following is the framework and content of the courses of the M.Phil program in Molecular Cell Biology and Genetics, which is offered through Pathology department.

GENERAL OBJECTIVES AND DESCRIPTORS OF ALL M.PHIL PROGRAMS (IN ACCORDANCE WITH EU GUIDELINES)

M.Phil programs at KEMU not only provide students with an outstanding education but also encourage them to self-directed, theoretical and practical learning. These above mentioned attributes are at the forefront of knowledge in every specialized field that provides a basis for originality in developing and/or applying ideas, often within a research context. The aim of this exercise is to develop conceptual understanding that enables the student; to evaluate critically current research and advanced scholarship in the discipline; and to evaluate methodologies and develop critiques of them and, where appropriate, and to propose new hypotheses.

M.Phil programs at KEMU also recognize and reinforce the ability of students to integrate knowledge and formulate judgments. Students are also directed to take account of social and ethical issues and responsibilities and also reflect experience of managing change in a complex environment. The learning process at this level is associated with independent working with other people at the same level or higher. All feasible efforts will be made by the departments to provide students an opportunity to develop the work or learning according to student's scholastic interest.

During the course of M.Phil training, students will be presented with unfamiliar learning situations and will be required to solve problems that involve many obscure and interacting factors. Many such factors are typically variable, making the learning context complex and unpredictable. The overall impact of these exercises is to:

1. Ensure a highly specialized education and its application in problem solving to ensure access to employment requiring decision-making in complex and unpredictable situations

2. Nurture independent learning ability required for continuing professional development Career progression within the respective field.

Clinical Molecular Cell Biology and Genetics
M. Phil Program Faculty

Program Director: Professor Dr. Fridoon Jawad Ahmad

Regular Faculty: Professor Dr. Muhammad Munir

Professor Dr. Samina Naeem

Associate Professor Dr. Ihtesham Uddin Qureshi

Assistant Professor Dr.Mulazim Hussain Bukhari

Visiting Faculty: Professor Dr. Ali Jawa

Program Outline

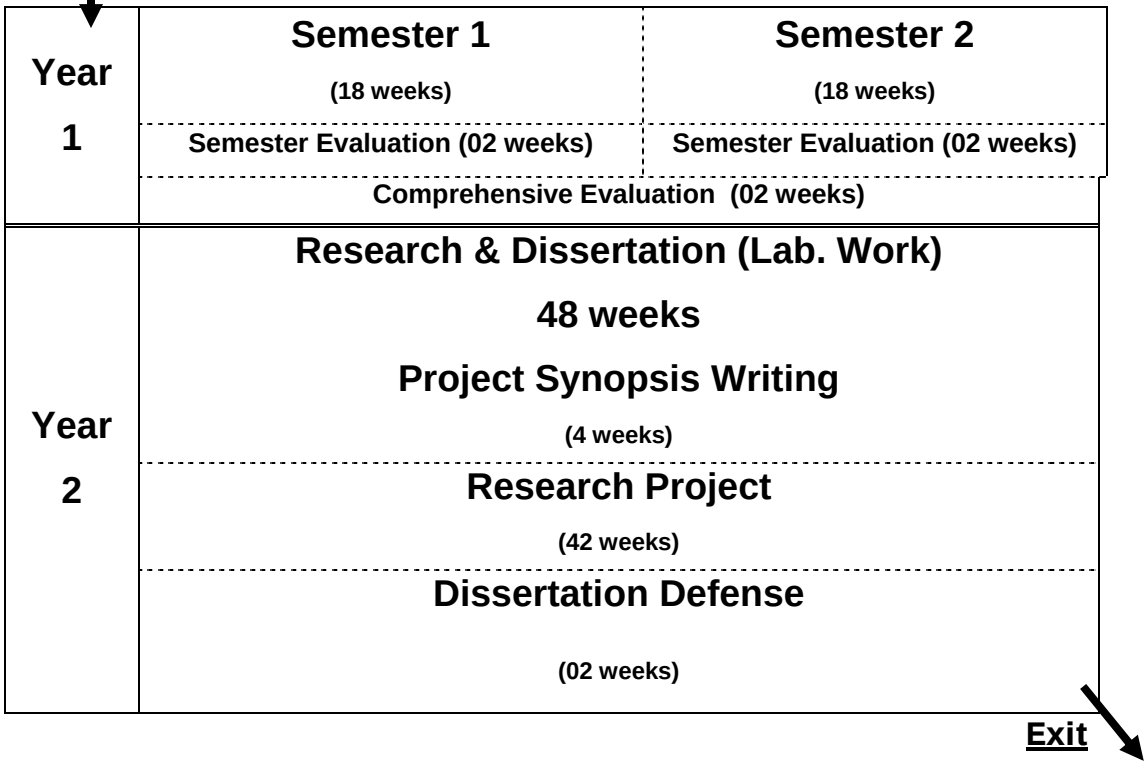
Duration of the Program: 02 Years (Full Time)

Entry Qualifications: MBBS/BDS/BS.c Hons/MS.c
(minimum 16 years of education).

Entry Procedure; GRE Type Entry Test (MCQ Based)
Written Test at Faculty of Basic Sciences Level
Interview at Department of the Program Level

Phase of Studies in Basic Curriculum:

Entry



Year 1 is semesterized into two Semesters of twenty (20) weeks each whereas year two (2) is annual of forty eight (48) weeks. Each module and the whole program is made credit based according to the following criteria.

Credit Accumulation and Transfer System (CATS)

As defined by European Credits Transfer system, the CATS – KEMU is defined as follows

1. Contact Hours 1500 – 1800 hrs/year
2. 25 – 30 Contact Hours = 1 Credit Point
3. Number of Credit Point Required in a Year = 60
4. Number of Credit Point Required in a Semester = 30

Curriculum Outline and Learning Schedule

First Year

First Semester:

Teaching	18 weeks
Review and Evaluation	02 weeks
Total	20 weeks

Summer Recess

Second Semester:

Teaching	18 weeks
Review and Evaluation	02 weeks
Total	20 weeks

Winter Recess

Second Year

Project Synopsis Writing	04 weeks
Research Project	42 weeks
Dissertation Defense	02 weeks

Year 1 Semester 1

Class Schedule

Module N.o	701	702	703	704	705	706
Duration	**2 weeks**	**2 weeks**	**2 weeks**	**2 weeks**	**5 weeks**	**5 weeks**
Title of Module	**Introduction to Molecular Cell Biology**	**Research Methods & Biostatistics**	**Molecular Biology & Genetics**	**Basic Medical Sciences**	**General Pathology**	**General Microbiology and Microbial Genetics**
Module Coordinator	**Prof. Fridoon**	**Prof. Syed Muhammad Awais**	**Prof. Fridoon**	**Multi Disciplinary**	**Prof. Muhammad Munir**	**Prof. Muhammad Munir**
Place of Learning	**Department Lecture Room**	**Patiala Block**	**Patiala Block**	**Department Lecture Room**	**Department Lecture Room**	**Department Lecture Room**

Course Content

Semester I

Module 701 Introduction to Molecular Cell Biology
(2 Weeks/3 Credit Hours)

Course Description and Learning Objectives:

- This course is the first in the series of two courses designed to introduce both classical and contemporary topics in biology to the students.
- After taking this course students will be expected to have a basic understanding of molecular organization of the cell and the biological role of the molecular machinery of the cell.

Course Contents:

1. An Evolutionary Framework for Biology
2. Life and Chemistry: Small Molecules
3. Life and Chemistry: Large Molecules
4. Cells: The Basic Units of Life
5. Cellular Membranes
6. Energy, Enzymes, and Metabolism
7. Cellular Pathways That Harvest Chemical Energy
8. Photosynthesis: Energy from the Sun
9. Chromosomes, the Cell Cycle, and Cell Division
10. Genetics: Mendel and Beyond
11. DNA and Its Role in Heredity
12. From DNA to Protein: Genotype to Phenotype
13. The Genetics of Viruses and Prokaryotes
14. The Eukaryotic Genome and Its Expression

Seminar Topics:

1. Chromosomes and Inheritance
2. Recombinant Biotechnology
3. Stem cell Therapeutics
4. Transport Channels
5. Biotechnology in Medicine

Book Recommended:

1. Life, 'The Science of Biology' by Craig Heller

Module 702 Research Methods & Biostatistics
(2 Weeks/3 Credit Hours)

Course Description and Learning Objectives:

- To help participants to formulate ideas that can be tested in a scientific manner
- To give participants a basic understanding of epidemiological methods and biostatistics.
- To develop the critical faculties of participants for evaluation of their own and other people's work.
- To give practical experience of development of study protocols and applications for research funding.
- To give practical experience of use of computers for word processing, database manipulation, use of spreadsheets, statistical analysis, preparation of slides and overheads, internet communication and video conferencing and report writing.

Course Contents:

1. Research Methods
    - Philosophy, language, types and structure of Research
    - Conceptualizing research, problem formulation, research objectives
    - Review of literature, sources of knowledge
    - The Planning-Evaluation Cycle
    - Sampling terminology, Probability sampling, Non-probability sampling, Bias and Error
    - Time in Research, Types of Relationships
    - Variables, Hypotheses, Types of Data
    - Introduction to Design, Types of Designs
    - Experimental Design
    - Survey Research, Types of Surveys
    - Qualitative research, Qualitative Data
    - Introduction to Design, Types of Designs, Experimental Design
    - Questionnaires
2. Biostatistics
    - Data display and summary, mean and standard deviation
    - Populations and samples
    - Statements of probability and confidence intervals
    - Differences between means: type I and type II errors and power
    - Differences between percentages and paired alternatives
    - The t tests and the chi-squared tests
    - Correlation and regression
    - Study design and choosing a statistical test

3. Epidemiology
    - What is epidemiology?
    - Quantifying disease in populations
    - Comparing disease rates
    - Measurement error and bias
    - Planning and conducting a survey
    - Ecological studies, Longitudinal studies, Case-control, cross sectional studies and experimental studies
4. Technical Writing
    - Synopsis writing
    - Grant proposal writing
    - Research paper writing
    - Thesis outline
    - Thesis writing

Module 703

Molecular Cell Biology

(2 Weeks/3 Credit Hours)

Course Description and Learning Objectives:

- This course is the second in the series of two courses designed to introduce both classical and contemporary topics in biology to the students.
- This course is structured to entertain students irrespective of their major.
- After taking this course students will be expected to have a basic understanding of the following fundamental concepts

    1. The role of cellular and molecular biology in medicine.
    2. Immunology.
    3. Molecular and cellular developmental biology (“miracle of life” formation of a complex organism from a single cell).
    4. Evolution with a molecular perspective (natural force and their effect in transformation of life).

Course Contents:

1. Recombinant DNA and Biotechnology
2. Molecular Biology and Medicine
3. Natural Defenses against Disease
4. Differential Gene Expression in Development
5. Animal Development: From Genes to Organism
6. Development and Evolutionary Change
7. The History of Life on Earth
8. The Mechanisms of Evolution
9. Species and Their Formation
10. Reconstructing and Using Phylogenies
11. Molecular and Genomic Evolution

Seminar Topics:

1. Genes and Development
2. Recombinant Biotechnology
3. Molecular and Genomic Evolution
4. Molecular Evolution
5. Molecular Immunology

Book Recommended:

1. Life, 'The Science of Biology' by Craig Heller

Module 704

Basic Science

(2 Weeks/3 Credit Hours)

Course Description and Learning Objectives:

- This is a multidisciplinary course that in two weeks gives students basic knowledge of the five pillars of basic medical sciences i.e. Anatomy Physiology Pathology Biochemistry And Course Pharmacology.
- Student taking this course will be able to understand

Course Contents:

Anatomy

1. Embryology
    - Fertilization, Zygote, Morula, Blastula, Gastrula, Embryonic period Derivatives of germ layers
    - Brief account of Amnion, Chorion, Placenta
    - Out line of development of Heart and its Anomalies
    - Brief account of development of Urogenital, Digestive systems
2. Histology
    - Cell,
    - Tissue (Epithelial tissue, Muscular tissue, Connective tissue and Nervous tissue)
    - General plan of microscopic structure of CVS
    - Systems (Respiratory, Urogenital, Digestive systems)
3. General Anatomy
    - Classification of bones, their blood supply and ossification
    - Classification of Joints Nerve Supply and Blood supply
    - Types and Nerve supply of Muscles
    - Definition of Neuron and Peripheral and Central nervous system
    - Surface marking of Heart, Lungs, Abdominal viscera

4. Thorax
    - Thoracic cage movements
    - Heart and its External and Internal features and Blood supply
    - Lungs, Pleura, Mediastinum (Name of contents)

5. Abdomen
    - Disposition of Abdominal and Pelvic viscera
    - Outline of Blood supply
    - Nerve supply and Lymphatic drainage and Peritoneal relation of visceras
6. Head & Neck
    - Bones, Foramina of skull
    - Names of Cranial nerves, Brief outline of 5^{th} & 7^{th} Cranial nerves
    - Dural venous sinuses, Blood supply and Nerve supply (brief account)
    - Nose, Pharynx and Larynx. (Blood supply and Nerve supply)

Physiology

1. Functional organization of the human body and control of the internal environment
2. Extra cellular fluid
3. Homeostasis
4. Dehydration and Rehydration and K+ Homeostasis
5. Anemia, Polycythemia
6. Resistance of body to infection-the leukocytes, tissue macrophage system and inflammation
7. Immunity and allergy
8. Hemostasis and blood coagulation
9. Cardiovascular system properties of cardiac output CCF test cardiac function & Hypertension Normal ECG Acid Base Balance urine formation
10. Respiration Spirometery Regulation Real Electrocardiogram.
11. Body fluids & kidneys; regulation of acid-base balance
12. Pulmonary blood flow
13. The nervous system and special senses
14. The gastrointestinal tract
15. Metabolism and temperature regulation
16. Endocrinology and reproduction
17. Sports Physiology
18. Ovarian and testicular function tests
19. Thyriod Parathyriod Adrenal pancreas endocrine hypothalamus

Pathology

1. Structure and functions of normal human cell inflammatory reaction, chmical mediators primary and secondary wound healing. Factors affecting the process of healing. Healing in fractured long bone.
2. Gram + Ve orgmisms and lesions produced by them. Cram- Ve orgnanisms and lesions produced by them. Mycobactcrial infections, lesions and laboratory diagnosis. Viral infections like Hepatitis, AIDS, Polio, Hepez, Measels etc. Fungal infections-superficial deep seated and opportunistic. Parasites of medial importance and their lab. Diagnosis such as protozoa, tape worms and round worms

3. Etiology and pathogenesis of thrombosis, complications and diagnosis thrombosis, type, mechanisms of change of various emboli, infarction and its diagnosis.
4. Nomenclature etiology of tumors, benign and malignant tumour , route of spread of malignant Tumour, effects of tumors, oncogens, Tumour suppress genes, tumour markers, and their diagnostic significance, some protype specific Tumour.
5. Pathologic calcifications. Its types and lesions, various exogenous and endogenous pigments and lesions. Deficiency diseases and lesions.
6. Physical irritants and lesions produced by them. Ionizing Radiations and lesions produced by them. Chemical agents as a cause of tissue injury.
7. Rheumatic, ischemic and congenital Heart disease, Endocarditis. Antheroma-its etiology, lesions and complications.
8. Glomeruloncphritis, pyclonephritis, stones renal tumours diabetic Nephropathy.
9. Bronchiectasis, emphysema, pneumonias, tumours, tuberculosis pncumoconiosis.
10. Oesophageal lesions, peptic ulcer, gastritis, tumous of stomach, inflammatory bowel diseases, tuberculosis of intestine,tumours of intestine.
11. Tumours of bones, inflammation of bones and giants, muscle dystrophy important skin lesions and their diagnosis, inflammations and tumours in oral cavity including teeth and jaws.
12. Tumours of C.N.S inflammations of meninges and their lab diagnosis demyelinating diseases.
13. Tumours of lymph nodes and lcukemias, multiple mycloma- lesions and lab diagnosis.

Biochemistry

1. Fluid & Electrolyte & Acid Base Balance in Human Body with select Clinical Scenarios.
    - Constitution of Extra & Intracellular Fluids.
    - Extracellular Fluid Compartments; Select Dehydration & Oedema Development & Management.
    - Intracellular Fluid Compartments; Select Dehydration & Oedema Development & Management.
2. Metabolic Cross Talk in Glycomics. Health & Disease Scenarios.
    - Site, Pathway Dynamics, Key & Regulatory Enzymes, Nutritional & Endocrine Command, Outcome & Clinical Complications in Glycolysis, Hexose Shunt Pathway, Glycogenesis & Glycogenolysis, Kreb's Pathway & Glucuronic Acid Pathway.
3. Metabolic Cross Talk in Lipomics. Health & Disease Scenarios.
    - Site, pathway Dynamics, Key & Regulatory Enzymes, Nutritional & Endocrine Command, Outcome & clinical Complications in Fatty Acid Oxidation & Biosynthesis, Ketosis, Cholestrogenesis & Lipoproteins.
4. Metabolic Cross Talk in Proteomics. Health & Disease Scenarios.
    - Site, pathway Dynamics, Key & Regulatory Enzymes, Nutritional & Endocrine Command, Outcome & clinical Complications in Urea Cycle, Protein Biosynthesis & Select Amino acid Metabolism with Genetic Disorders.
5. The Liver & Biliary System.
    - Liver Functions & Liver Function Tests, Biliary Stasis, Cholecystitis & Pancreatitis, Jaundice.

6. Nutrition & Endocrines Modalities.
    - Basic Nutritional Principles & Calorific Requirements. Diet in health & Disease.
    - Biosynthesis, Storage, Mechanism of Release, Transport, Binding to Receptor, Mode of Activity, Biochemical Functions & Abnormalities in Vitamin A, D, K, C & B Complex.
    - Biosynthesis, Storage, Mechanism of Release, Transport, Binding to Receptor, Mode of Activity, Biochemical Functions & Abnormalities in Insulin, Glucagon, Thyroid Hormones, Para thyroid Hormones, Calcitonin, Growth Hormone, Aldosterone, Corisol & Catacholamines.

Course Pharmacology

1. Basic principles: Drug receptors and pharmacodynamics, pharmacokinetics, drug biotransformation
2. Autonomic drugs
3. Cardiovascular drugs
4. Renal drugs
5. Drugs with action on smooth muscles
6. Drugs that act in the central nervous system
7. Drugs used to treat diseases of blood, inflammation and gout
8. Endocrine drugs
9. Chemotherapeutic drugs
10. Special aspects of perinatal, pediatric and geriatric pharmacology
11. Drugs used in gastrointestinal diseases
12. Therapeutic and toxic potential of over the counter drugs. Local acting Drugs.

Module 705

General Pathology

(5 Weeks/9 Credit Hours)

Course Description and Learning Objectives:

- Describethe responses to different types of injury at the cellular and sub-cellular level
- Enlist the differences between necrosis and apoptosis
- Describe different morphological patterns of tissue necrosis
- Describe the different types of responses of the cells to stress
- Describe the different types of exogenous and endogenous pigmentations
- Describe the sequence of vascular changes in acute inflammation (vasodilation, increased permeability) and their purpose
- Define the terms edema, transudate, and exudate
- Describe the steps involved in phagocytosis and the role of IgG and C3b as opsonins and receptors
- Compare and contrast acute vs chronic inflammation with respect to causes, nature of the inflammatory response, and tissue changes10. Describe the differences between the various cell types (i.e. labile, stable, and permanent cells) in terms of their regeneration potential. List examples of each cell type

- Distinguish between fibrinous, purulent, and serous inflammation. Define an abscess
- Describe the systemic manifestations of inflammation and their general physiology, including fever, leukocyte left shift, and acute phase reactants
- Define and understand the process of excessive growth of different types of cell
- Differentiate the non-neoplastic excessive and neoplastic growths
- Understand the differences between benign and malignant tumors
- Understand the classification of different tumors
- Understand the TNM classification of malignant tumors
- Define and describe hyperemia and congestion, edema, hemorrhage, thrombosis, infarction and embolism
- Describe shock, its different types and understand mechanisms leading to shock.
- Describe the organization of nuclear material, its replication and division
- Understand different modes of inheritance
- Describe the different types of genetic aberrations
- Understand the basis of molecular diagnosis of genetic disorders
- Define the components of the immune system
- Understand the innate and adaptive immunity, the classes of immunoglobulins
- Define humoral and cellular immunity
- Define the differences between immunity and hypersensitivity
- Describe the autoimmune diseases and their diagnosis
- Understand the immune deficiency states

Course Contents:

1. Cellular Basis of disease (Cellular responses to stress ; Adaptations of growth and differentiation, Cell injury and cell death)
    - Hyperplasia
    - Hpertrophy
    - Atrophy
    - Metaplasia
    - Causes of Cell injury
    - Mechanisms of cell injury
    - Reversible and irreversible cell injury
    - Morphology of cell injury and necrosis
    - Apoptosis
    - Sub cellular responses to injury
    - Intracellular accumulations
    - Pathological calcification
2. Inflammation and healing
    - Acute Inflammation
    - Chemical mediators of inflammation
    - Outcomes of acute inflammation
    - Morphologic patterns of acute inflammation
    - Systemic effects of inflammation
    - Mechanisms of tissue regeneration
    - Repair by healing ,scar formation and fibrosis

3. Hemodynamic disturbances,
    - Edema
    - Hyperemia and congestion
    - Hemorrhage
    - Hemostasis and thrombosis
    - Embolism
    - Infarction
    - Shock
4. Neoplasia
    - Biology of tumor growth
    - Benign and Malignant Neoplasms
    - Molecular basis of cancer
    - Host defenses against tumors
    - Clinical features of tumors
5. Genetic Disorders
    - Mutations
    - Mendelian disorders
    - Disorders with multifactorial inheritance
    - Cytogenetic disorders
    - Single Gene disorders
    - Molecular diagnosis
    - Diagnosis of Genetic diseases
6. Diseases of immunity
    - General features of immune system
    - Cells and tissues of the immune system
    - Innate and adaptive immunity
    - Disorders of the immune system
    - Autoimmune diseases
    - Immunological deficiency syndromes

Book Recommended:

1. **Robbins Basic Pathology Updated Edition: With STUDENT CONSULT Online Access** by Vinay Kumar, Ramzi S. Cotran, and Stanley L. Robbins

Module 706

General and Molecular Microbiology, and Microbial Genetics

(5 Weeks/9 Credit Hours)

Course Description and Learning Objectives:

- Describe the generalized symptoms and signs, of a patient suspected to be suffering form a probable infectious disease and obtain the clinical specimens for the laboratory diagnosis.
- Describe the internal and external structures of the prokaryotic organisms and to understand their role in the pathogenesis of the infectious diseases
- Describe the living of microorganisms, their nutritional requirements and their metabolic pathways, with special reference to causation of disease.
- Define the organization of the genetic material in prokaryotic cells and their transfer among themselves.
- Enlist the impact of the conjugation, transformation and transduction in the evolution and survival of the bacteria
- Describe the physical and chemical methods used to kill the microorganisms and the application of the knowledge in control of the microorganisms in clinical settings.
- Describe the sterilization of the instruments, biological materials: reducing the microorganisms in the operation theaters, the air of the hospital wards ICUS: disinfections of instruments like endoscopes etc
- Enumerate the principles of epidemiology like the source of infection, reservoir of infection, modes of spread, routes of entry into the body, the infectious doses, vehicle of infection and the role of the biological vectors.
- Describe the antimicrobials with reference to their types, mechanism of actions, routes of administration, biological half life, their spectrum, bioavailability at site of infection, and other considerations regarding the their usage.
- The application of the knowledge obtained in developing the protocols for their usage in clinical settings.
- The know and understand the techniques and modalities of in vitro antimicrobial sensitivity testing and the standardization of such techniques
- To know and describe the mechanisms used by microorganisms in developing the resistance to antimicrobials and the impact of this resistance development on microbial survival and evolution of the infectious diseases.
- The know-how the mechanisms and modalities used by microorganisms in the pathogenesis of infectious diseases and their interaction with defense mechanisms of the body.
- The know define and describe the weapons of microorganisms like exotoxins, endotoxins, extracellular enzymes etc
- To know the organization of genetic materials in the microorganisms. The transfer of the genetic materials among the microorganisms.
- To know and describe the mechanisms of transfer of genetic material like conjugation, transformation, and transduction and their impact on survival of bacteria and evolution of the infectious disease.

- To know and understand the different types of infectious diseases prevalent in different geographical regions and advice the persons traveling to those areas about the preventive measures and to advice them on vaccination
- To understand the importance of clean drinking water and to describe the methods used for the microbiological testing of water supplies

Course Contents:

1. Approach To The Acutely Ill Infected Febrile Patient
    - Introduction
    - General Considerations
    - Specific Presentations
    - Conclusion
2. Bacterial Structure And Function
    - Internal Structure
    - Cell Membrane
    - Cell Wall
    - External Structure
    - Bacterial Groups
    - Gram Positive Bacteria
    - Gram Neagative Bacteria
3. Microbial Physiology
    - Microbial Metabolism
    - Microbial Growth
4. Microbial Genetics
    - Conjugation
    - Tranduction
    - Transformation
    - Genetic Engineering
5. Microbial Control
    - Physical Control
    - Heat Sterlizatization
    - Filter Sterilization
    - Radiation Sterlization
    - Chemical Control
    - Disinfectants
    - Antiseptics
6. Principles Of Epidemiology
    - Infectious Diseases Acquisition
    - Transmission
    - Antigenic Shift And Drift
7. Antimicrobial Actions
    - Approach To Antimicrobial Actions
    - Cell Wall Inhibitors
    - Agents Effecting Enzymes
    - Protein Synthesis Inhibitors
    - Agents Effecting Nucleic Acids

8. Antimicrobial Resistance
    - Acquisition Of Resistance Genes
    - Transfer And Spread Of Resistance
    - Permeability Alterations
    - Enzyme Inactivation
    - Target Site Alteration
9. Approach To Therapy For Bacterial Diseases
    - Treatment And Prophylaxis Of Bacterial Infections
    - Introduction
    - Mechanisms Of Action
    - Mechanisms Of Resistance
    - Pharmacokinetics Of Antibiotics
    - Principles Of Antibacterial Chemotherapy
    - Choice Of Antibacterial Therapy
    - Adverse Reactions
    - Drug Interactions
    - Prophylaxis Of Bacterial Infections
    - Duration Of Therapy And Treatment Failure
    - Antibacterial Costs And Inappropriate Use
10. Molecular Mechanisms Of Microbial Pathogenesis
    - Introduction
    - Microbial Entry And Adherence
    - Microbial Growth After Entry
    - Avoidance Of Innate Host Defenses
    - Tissue Invasion And Tissue Tropism
    - Tissue Damage And Disease
    - Transmission To New Hosts
11. Immunization Principles And Vaccine Use
    - Introduction
    - Impact Of Immunization
    - Definitions
    - Principles Of Immunizatization
    - Approaches To Active Immunization
    - Approaches To Passive Immunization
    - Route Of Administration
    - Age
    - Adjuvant Potentiation
    - The Immune Response
    - Immunization Principles And Vaccine Use
    - Herd Immunity
    - Target Populations And Timing Of Immunization
    - The Development Of Vaccines
    - Use Of Vaccines
    - Control Of Vaccine-Preventable Disease
    - Research On Vaccines And Immunization
    - International Considerations
    - Sources Of Information On Immunization

12. Health Advice For International Travel
    - Introduction
    - General Advice
    - Travel And Special Hosts
    - Problems After Return
13. Bacteriological Testing Of Water

Books Recommended:

1. Medical Microbiology & Immunology, by Warren Levinson & Ernest Jawetz and is available in the bookstore of Allama Iqbal Medical College.
2. Principles of Virology: Molecular Biology, Pathogenesis, and Control by S.J. Flint, L.W. Enquist, R.M. Krug, V.R. Racaniello, and A.M. Skalka, ASM Press, 2nd edition (2000). 101: Molecular Biology
3. Jawetz, Melnick and Adelbergs, Medical Microbiology Ed.2
4. Monica Cheesbrough, Medical Laboratory Manual for tropical countries Ed.3

Year 1 Semester 2

Class Schedule

Module N.o	707	708	709	710	711	712
Duration	3 weeks	3 weeks	3 weeks	3 weeks	3 weeks	3 weeks
Title of Module	Molecular Biology-I	Cell Biology-I	Bio-technology	Virology	Molecular Biology-II	Cell Biology-II
Module Coordinator	Visiting Faculty	Prof. Fridoon	Prof. Fridoon	Visiting Faculty	Visiting Faculty	Prof. Fridoon
Place of Learning	Department Lecture Room	Patiala Block	Patiala Block	Department Lecture Room	Department Lecture Room	Department Lecture Room

Course Content

Semester II

Module 707&711 **Molecular Biology I & II**
(2X3 Weeks/2X5 Credit Hours)

Course Description and Learning Objectives:

- This course will discuss basic principles of molecular biology, with emphasis on the molecular mechanisms that govern the fundamental processes in biological information transfer DNA->RNA-> protein.

Course Contents:

1. Structure of Nucleic Acids
2. Molecular structure and organization of Genes, Genome and Chromosomes
3. DNA Replication
4. DNA Recombination
5. From DNA to RNA: Transcription
6. Regulation of Transcription Initiation
7. RNA Processing, Nuclear Transport, and Post-Transcriptional Control
8. From RNA to Protein: Translation
9. Selection of mRNAs to be translated
10. mRNA degradation and interference
11. Protein activity: Post-translational modifications, activation, localization, and degradation
12. Protein structure and function

Seminar Topics:

6. DNA Diagnotics
7. RNAi in Medicine
8. Protein structure and function
9. Regulation of Transcription
10. RNA Processing and Post-Transcriptional Control

Books Recommended

1. Gene vii by Lewin Benjamin.
2. Molecular Biology of gene by Watson.
3. The Cell (3rd Edition) by Bruce Albert Dennis Bray.
4. Biochemistry (3rd Edition) by Victor L Davidson Donald B-Sihman.

Module 708 & 712

Cell Biology I&II

(2X3 Weeks/2X5 Credit Hours)

Learning Objectives:

- This course is designed to help students understand workings of the cell structure and function at cellular and molecular level.
- In this course molecular basis of cell structure and function is discussed which will provide students a detailed account of functional physiology of the cells.
- Furthermore, this course will discuss the key components of the immune system at cellular and molecular level.

Course Contents:

1. Cell Signaling
    - An over view of ligand receptor interaction and signal transduction
    - G protein-coupled receptors and their effectors
    - Tyrosine kinase and Ras
    - Map kinase pathway
2. Cell Adhesion and ECM
    - Cell adhesion molecules
    - Collagen Matrix
    - Non-collagen Matrix
    - Metastasis.
3. Protein sorting
    - An overview of protein targeting
    - Peroxisomal protein targeting
    - Secretory protein targeting
    - Membrane proteins
    - Post-translation modifications
    - Golgi protein sorting
4. Vesicular Transport
5. Cell membrane and transport
    - Cell membrane structure and function
    - Ion channels and active transport
    - Regulation of transport across cell membrane
6. Cytoskeleton and force generation

- An overview of Actin, Microtubules and intermediate filaments
- Actin dynamics
- Actin myosin interaction and regulation
- Microtubule dynamics (dynamic instability model)
- MAPS and microtubule motors
- Vesicle transport and mitosis
- Cilia and flagella structure and movement

7. Cell cycle and Apoptosis
   - An over view of cell cycle
   - Molecular mechanism of cycle regulation
   - Regulation of cell cycle in Yeast and mammalian cells
   - Proto-Oncogenes and tumor suppressor genes
   - Apoptosis
8. Immune System
   - Cellular composition of the immune system
   - Antibody structure and function
   - Generation of antibody diversity
   - MHC Complex structure and function
   - Helper T cells and their activation
   - Cytotoxic T cells selection

Seminar Topics:

11. Therapeutic Use of Signaling Molecules
12. Role of ECM in Cell Signaling
13. Protein sorting
14. Mechanisms of Force Generation in Cell
15. Regulation of cell cycle
16. Molecular Immunology

Books Recommended

1. Introduction to Immunology by Jhon W. Kimball
2. Essential Immunology by Roit
3. Microbiology by Davis & Delbeco
4. The Cell (3rd Edition) by Bruce Albert Dennis Bray.
5. Molecular Biology of gene by Watson.

Module 709

Biotechnology

(3 Weeks/5 Credit Hours)

Learning Objectives:

- Upon completion of the course, students should have gained an understanding of how, when and why certain techniques, instruments and skills are used in a research setting.
- They will acquire the skills needed to maintain a good laboratory practices and learn about Do's and Don'ts of operating various instruments.
- This course also enables the student to develop proficient Molecular Biology laboratory skills including analyzing a protocol, making reagents, maintaining a GLP (Good Laboratory Practices) notebook, presenting experimental data for the group.
- Students will gain basic knowledge to bioinformatics, search/use of molecular databases, use commonly available software for the analysis of sequences and primer design.

Course Contents:

1. Good Laboratory Practices Doe's and Don'ts
2. Review of microbiological and lab techniques
3. Review of pipetting techniques
4. Media preparation, making reagents and data recording
5. Writing a scientific report/paper
6. Enhancement of English language
7. Research ethics
8. Cell and Tissue Culture (Mammalian/plant)
9. Tissue processing and Immunohistochemistry
10. Microscopy
11. Animal Cloning
12. Sterilization
13. Scintillation Counting
14. DNA Sequencer and Autoradiography
15. Ultracentrifugation
16. Chromatography
17. Gel Electrophoresis
18. Spectrophotometeric Techniques
19. Accessing the publicly available databases
20. Sequence information, searching databases
21. An Introduction to the Vector/primer design Program

Seminar Topics:

17. Cell and Tissue Culture
18. Research ethics

19. Tissue processing and Immunohistochemistry
20. Animal Cloning
21. Microscopy

Books Recommended

1. Current Protocols in Molecular Biology by Frederic M. Ausubel & Roga B. Massachusetts General Hospital & Harvard Medical School.

2. Molecular Biology, Robert Weaver, WBC McGraw Hill, NY. 2001, ISBN 00072345179.

Module 710

Virology

(3 Weeks/5 Credit Hours)

Learning Objectives:

- This is an advance level course that describes various biological and molecular aspects of viruses. Our coverage will focus almost entirely on viruses that infect humans and cause serious disease.
- The course is divided into 3 parts. Module 1 deals with the general aspects of Virology: classification, modes of infection, replication and pathogenesis in a comparative fashion. Module II includes more specialized topics, i.e., Host-virus interactions including Transformation and oncogenesis, immunopathology, Host defense mechanisms, antiviral pharmacology and applied virology. Module III discusses various plant viruses and their associated diseases.

Course Contents:

1. Introduction to Virology
2. Viral Classification and Structure
3. Virus Genomes/ Viral Genetics: Linear, Circular, DNA or RNA
4. Viral Infection: Attachment, penetration, uncoating.
5. Viral Gene Expression: Early and late gene expression
6. Viral Replication: Lytic and latent life cycles
7. Viral Pathogenesis: Virulence, Cytopathic effects, Host responses
8. Viral Transformation
9. RNA transforming viruses
10. DNA transforming viruses
11. Host Defense Mechanisms
12. Apoptosis
13. Immune activation
14. Anti-Viral Pharmacology
15. Vaccines

16. Antiviral drugs
17. Applied Virology
18. Viral vectors and gene therapy

Seminar Topics:

22. Anti-Viral Pharmacology
23. Viral Pathogenesis: Virulence, Cytopathic effects, Host responses
24. RNA transforming viruses
25. DNA transforming viruses
26. Antiviral drugs
27. Viral vectors and gene therapy

Books Recommended

1. Medical Microbiology & Immunology, by Warren Levinson & Ernest Jawetz and is available in the bookstore of Allama Iqbal Medical College.
2. Principles of Virology: Molecular Biology, Pathogenesis, and Control by S.J. Flint, L.W. Enquist, R.M. Krug, V.R. Racaniello, and A.M. Skalka, ASM Press, 2nd edition (2000).
3. Fundamental Virology: 4th edition (2001), edited by D.M. Knipe and P.M Howley, Lippincott Williams and Wilkins.
4. Viral Pathogenesis: by Nathonson.

Year Two

Research & Dissertation (Lab. Work)
48 weeks
Project Synopsis Writing
(4 weeks)
Research Project
(42 weeks)
Dissertation Defense
(02 weeks)