



CURRICULUM
FOR
MPHIL MOLECULAR BIOLOGY
SHAHEED ZULFIQAR ALI BHUTTO MEDICAL
UNIVERSITY, ISLAMABAD,
PAKISTAN

LIST OF COURSES OF MPhil MOLECULAR BIOLOGY

Course Code	Course Title	Credit Hours
MAJOR COURSES		
MOLBIO601	Advances in Molecular Biology	3(3-0)
MOLBIO602	Genetics & Epigenetics Mechanisms of Gene Regulation	3(2-1)
MOLBIO603	Professional responsibilities of molecular Biologist	3(3-0)
MOLBIO604	Biologics	3(3-0)
MOLBIO605	Bioinformatics	3(2-1)
MOLBIO606	Molecular Biology Research Techniques	2(1-1)
MOLBIO607	Personalized Genomic Medicine	3(3-0)
OPTIONAL COURSES		
MOLBIO608	Physiology of Sensory System	3(3-0)
MOLBIO609	Molecular Immunology	3(2-1)
MOLBIO610	Clinical Genetics	3(2-1)
MOLBIO611	Biosafety and Bioethics	3(3-0)
MOLBIO612	Human and Animal Behavior	3(3-0)
MOLBIO613	Telemedicine and Medical Informatics System	3(3-0)
MOLBIO614	Tissue culture and Regenerative Medicine	3(2-1)

DESCRIPTION OF MPhil MOLECULAR BIOLOGY COURSES

MAJOR COURSES

MOLBIO601 – ADVANCES IN MOLECULAR BIOLOGY

Central Dogma of Molecular Biology. DNA Repair. Genetic Manipulation of Organisms: Recombinant DNA Technology and Genetic Engineering; Identification and Isolation of gene of interest; Restriction Endonucleases; Cloning Vectors; Gene Cloning; Bacterial Transformation; DNA Amplification by Polymerase Chain Reaction and its Applications. The molecular basis of disease, Molecular and genetic markers, Detection of mutations, DNA vaccines, Edible vaccines, Applications of transgenic animals (animal models of diseases) Drug delivery systems, Strategies of gene therapy, gene delivery vehicles, Comparative Genome hybridization, Karyotyping, Different Types of Florescence in situ hybridization techniques and their Medical applications. Prospectus and applications of Nano biotechnology in the field of Medicine and health. Nanoparticles uses as probes, sensors or vehicles for biomolecule delivery in cellular systems. Wireless pharmacology and ontogenetic. Neural recording and Modulation Technologies. Nanotechnology and smart medicines, Nanotechnology an enabling technology in the fields of personalized medicine and cancer, Nanomaterials and Nanoparticles.

RECOMMENDED BOOKS:

- Molecular Biology of the Cell, (2008) 5th Editon .B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts & P. Walter 5th Edition Garland Sciences, Taylor and Francis.
- Molecular Cell Biology (2007) 6th Edition. H. Lodish; C.A. Kaiser; M.Krieger. M.P. Scott; A. Bretscher; H. Ploegh; & P. Matsudaira; W.H. Freeman.
- Medical Biotechnology by JuditPongracz, Mary Keen “(2009). Published by Elsevier Health Sciences.
- The Delivery of NanoParticles Edited by Abbass A. hashim ISBN 978-953-51-0615-9 May 2012
- Latest Review articles

MOLBIO602 – GENETICS & EPIGENETICS MECHANISMS OF GENE REGULATION

Gene Expression in Eukaryotes, Promoters and various consensus sequences. Mechanism of splicing and its control. Molecular Mechanisms of Gene recombination and gene conversions. Importance of Genetic and Epigenetic regulatory mechanisms in development of human life, Mitotic heritability of Epigenetic State, DNA packaging into chromatin, DNA methylation, Post-translational modifications, chromatin Remodeling, Histone variants, Non coding RNAs, Dosage compensation. X Chromosome Inactivation, stages of X Chromosome Inactivation. Epigenetic Reprograming and Genomic Imprinting - Developmental Origins of Human health and Disease, Overkalix studies, Transgenerational epigenetic inheritance through gametes in Humans, Model system studies of environmental influence on epigenetic state and mechanisms of transgenerational epigenetic inheritance. Cancer Epigenetics, Clinical Implications of aberrant epigenetic control, Epigenetic changes in aging. Epigenetic Technologies and their clinical implications.

PRACTICALS

1. Strategies for tracking of genes on chromosomes.
2. Orientation with various DNA analysis methods and their applications in Diagnosis of Diseases.
3. Epigenetic technologies: Bisulfite conversion analysis, Methylation Based PCR, Combined Bisulfite Restriction Analysis (CoBRA), Restriction Landmark Genomic Scanning (RLGS)
4. Extraction and estimation of macromolecules (DNA, RNA and proteins)
5. Qualitative separation of macromolecules using electrophoresis.
6. RFLP analysis
7. Karyotyping of normal and abnormal human chromosomes
8. Screening of Genetic Disorders by Genetic Browsers.
9. General description of a PCR experiment
10. Problems related to Mendelian inheritance, gene interaction, gene mapping.

RECOMMENDED BOOKS:

- Epigenetics (Cold Spring Harbor Laboratory Press 2007). C. David Allis, Thomas Jenuwein, Danny Reinberg
- Epigenetics in Human Disease Edited by Trygve O. Tollefsbol Elsevier 2012
- Latest Review Articles in this field.

MOLBIO603 – PROFESSIONAL RESPONSIBILITIES OF MOLECULAR BIOLOGIST

COURSE OUTLINES:

Ethical issues in molecular research and the professional responsibilities of molecular biologist based on readings and occasional lectures. The topics are intended to cover the requirements for ethical training of students in Good laboratory practices, bioethics, biosafety and biosecurity and relevant international rules and regulation, recommendations of the regulatory authorities. Case studies on recent controversial issues.

MOLBIO604 – BIOLOGICS

COURSE CONTENTS:

Introduction to biologics and regulatory process. Biologics production process, prefield agroproducts, preclinical studies and good laboratory practice; clinical trials; containment and clean room requirements; special design and operational considerations; validations, good manufacturing practices and Inspection; format for quality module common technical documents; WHO system of acceptability in principle for the qualification of vaccine; changes to marketed drugs, introduction to the relevant regulatory authorities and laws.

RECOMMENDED BOOKS:

1. Calver, J.. 2012, Biologics: How to get your biological product to market and keep it there, Create Space Independent Publishing Platform.
2. Chow, S-H., 2013. Biosimilars: Design and Analysis of Follow-on Biologics. Chapman and Hall/CRC. Taylor and Francis Group,6000 NW Broken Sound Parkway, Suite 300 Boca Raton, FL 33487

MOLBIO605 – BIOINFORMATICS

Softwares for data retrieving and analysis, Genome projects: microbes, animals and human. Genomic and proteomic data, pair-wise sequence alignment, predicting the structure and function of DNA, RNA, and proteins from their primary sequences. Multiple sequence alignment, Construction of phylogenetic trees. Sequence analysis, genome annotation, computational evolutionary biology, measuring biodiversity, gene expression and regulation analysis, protein analysis, mutations analysis in cancer, structure prediction, modeling biological systems, high throughput image analysis. Data

Acquisition: Sequencing DNA, RNA and proteins, Determination of protein structure, Gene and protein expression data, Protein interaction data. Databases: Contents, Structure and Annotation: File formats, Annotated sequence databases, Genome and organism-specific databases, Retrieval of Biological Data: Data retrieval with Entrez and DBGET/LinkDB, Data retrieval with SRS (sequence retrieval system). Searching Sequence: Databases by Sequence Similarity Criteria: Sequence similarity searches, Amino acid substitution matrices, Database searches (FAST and BLAST), Sequence filters, Iterative database searches and PSI-BLAST. Multiple Sequence: Alignment-Genes and Protein Families, Conceptual models of protein structure, relationship of protein three-dimensional structure to protein function, The evolution of protein structure and function, Obtaining, viewing and analyzing structural data, Structural alignment, Classification of proteins of known three-dimensional structure: CATH and SCOP, Introduction to protein structure prediction by comparative modeling, Secondary structure prediction, Advanced protein structure prediction and prediction strategies

PRACTICALS:

- Different search engines for nucleotides and proteins.
- Access, retrieve, and analyze bioinformatics data available from several bioinformatics databases.

RECOMMENDED BOOKS:

- Baxevanis, A. D. and Ouellette, B. F. F. Bioinformatics: A Practical Guide to the Analysis of Genes and Proteins, 3rd ed. O'Reilly Publishers. 2004.
- Krane, D. E. and Raymer, M. L. Fundamental Concepts of Bioinformatics Benjamin Cummings. 2002.
- Krawetz, A., and D. Womble. Introduction to Bioinformatics. (A Theoretical and Practical Approach). Shumana Press, USA. 2002.
- Rastugi, S.C., N. Mendiratta and P. Rastugi. Bioinformatics: concepts, skills and applications. CBS Publishers. 2003.

MOLBIO606 - MOLECULAR BIOLOGY RESEARCH TECHNIQUES

Microscopy, centrifugation, spectroscopy, chromatography, and electrophoresis. Genomic DNA extraction, plasmid extraction, Southern, Northern and Western blotting, PCR, RFLP, AFLP's, RAPDs, Micro-sattelites, SNPs. DNA fingerprinting. Transformation, screening of transformed cells, restriction enzyme analysis and genotyping, NGS and WES.

MOLBIO607 - PERSONALIZED GENOMIC MEDICINE

Introduction to personalized genomic medicine, Architecture of Human genetic variation, Potential functional consequences of Single Nucleotide Variants in DNA , Mendelian Inheritance of disease, Genetic testing for mendelian diseases, increased disease Risk in carriers of autosomal recessive disorders, New Born Screening, Prenatal Genetic Testing, Prenatal genetic carrier screening, statistical and evidence basis of individualized treatment, Reading clinical data and genetic information together, drug metabolism and transport, absorption, metabolism, excretion, distribution, and interaction of the drug with its molecular target or targets to produce whole organ effects. Effects of genetics on these interactions. Variability of drug responses, Variability in drug therapy, genetic variability in drug handling molecules, Genetic variations across generations and geography, Genetic ancestry and genetic testing, Family history and inheritance patterns, Role of Linkage, GWAS and sequencing in diagnosis of diseases. Clinical Interpretations of variants, Methods of dissecting the genetic basis of complex diseases. Predictive testing for common complex diseases. Effects of Personalized genomic medicine on Cancer, Diabetes, heart failure, Marfan syndrome and neuropsychic disease, Principles of inherited diseases and Risk determination, Risk assessment using family history and histopathology, Genetic counseling-providing personalized patient education. Pharmacogenomics, candidacy of Patient for pharmacogenomics testing, hereditary cancer, tumor genetic landscape.

RECOMMENDED BOOKS:

- Molecular Biology of the Cell, (2008) 5th Edition .B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts & P. Walter 5th Edition Garland Sciences, Taylor and Francis.
- Human Molecular Genetics 4th Edition, T. Strachan and A.P. Read, Garland Science Press, April 2010
- Advanced Genetic Analysis: Genes, Genomes and Networks in Eukaryotes. Philip Meneely, ISBN-13: 978-0199219827 , Oxford University Press. 2009

- Molecular Biology of the Cell, (2008) 5th Edition .B. Alberts, A. Johnson, J. Lewis, M. Raff, K. Roberts & P. Walter 5th Edition Garland Sciences, Taylor and Francis.

OPTIONAL COURSES

MOLBIO608: PHYSIOLOGY OF SENSORY SYSTEM

Introduction: Receptors and sensations, sensory coding, transduction, types of receptors, mechanism of sensory adaptation, somatic and special senses. Somatic Sensations: Pain; types, receptors, transmission of signal to Central Nervous System and causes of pain, Headache and thermal sensations. Tactile Sensation: Sensory modalities, types of receptors and central projections, neural responses from smaller afferents, receptive fields, lateral inhibition, central responses. Proprioception: Muscle spindle; Golgi tendon organ, ultra-structure and function, vestibular apparatus; ultra-structure and function. Gustation: Primary sensations of taste, threshold for tastes, taste buds and their functions, transmission of taste signals, transduction mechanism and taste preference. Olfaction: Olfactory cells; structure, mechanism of excitation and adaptation, central olfactory projections and psychophysics of smell, transduction mechanisms and olfactory pathway. Visual System: Optics of vision: Physical principles of optics; refraction of light and application of refractive principles to lenses, optics of eye; mechanism of accommodation, image formation. Eye, photoreceptor and neural function of retina; photochemistry of vision and color vision mechanisms of adaptation and visual acuity and factors affecting visual acuity, visual pathways; function of lateral geniculate nucleus and visual cortex, fields of vision and eye movements and their control, visual localization and, autonomic control of accommodation and pupillary aperture. Auditory System: Structure of ear (external, middle and internal), nature of sound and sound spectra, Fourier analysis by cochlea and responses from auditory fibers, spatial localization of sound and determination of loudness, Impedance matching, functional organization of central auditory pathway.

RECOMMENDED BOOKS:

1. Guyton, A. C. and Hall, J. E Textbook of Medical Physiology. W. B. Saunders Co., 2005. (Recommended Textbook).
2. Carpenter, R. H. S. Neurophysiology, Oxford University Press, 2000.
3. Ganong. Review of Medical Physiology
4. Berne, R. M. and Levy, M. N. Physiology. Mosby Yearbook, 1992.

MOLBIO609 – MOLECULAR IMMUNOLOGY

Introduction to components of immune system, anti-body response; nature of anti-bodies, structure and heterogeneity of immunoglobulin, allelic exclusion; monoclonal anti bodies Adaptive and innate immunity, cells and organs of immune system, soluble mediators of immunity, antigens, immune responses, inflammation, defenses against intracellular and extracellular pathogens, Antibodies: Immunoglobulins, interaction of antibodies with antigens, function of antibodies, antibodies diversity, immunoglobulins gene recombination, somatic mutations. T-cell receptors and major histocompatibility molecules complex: T-cells receptors, genes of T-cell antigen receptors, Major histocompatibility complex molecules (MHC), interaction of MHC molecules with antigenic peptides, interaction of T-cells receptors with MHC and antigens. Antigen presentation: Antigen presenting cells, antigen processing and presentation, T-cell activation. Cytokines: Cytokines and cytokines receptors families, cytokine production by T-cells subset. Cell cooperation in antibody response: Development of B-cells, activation of B-cells by T-dependent and independent antigens. Mononuclear phagocytes in immune defense. Concepts in immunological tolerance; immunodeficiency, hypersensitivity type1-4; transplantation and rejection; autoimmunity. Histocompatibility: transplantation: HLA complex, HLA haplotypes, MHC/HLA and diseases, Immunological diseases: immune deficiency diseases, AIDS, auto immune diseases, inherited abnormalities of complement system.

PRACTICALS

1. Autoclaving and sterilization methods
2. Micropipeting centrifugation, spectroscopy, and electrophoresis.
3. Use of biosafety cabinets and hoods
4. Handling and use of various microscopes
5. Immunoassay:elisa enzyme linked immunosorbent assay
6. Preparation of standard solutions and buffers

RECOMMENDED BOOKS:

- Roitt, I and P.J. Delves. Roitts Essential Immunology. 10th Ed. Blackwell Science. 2001.
- Goldsby, R. A., Kindt, T. J., Osborne, B. A. and Kuby, J. Immunology, W. H. Freeman and Co Ltd., London, 2006 (Recommended Textbook).
- Roitt, I., Brostoff, J. and Male, D. Immunology, Mosby, Edinburgh, 2005
- Kindt, T. J., Osborne, B. A. and Goldsby, R. A. Immunology, W. H. Freeman and Co Ltd., London, 2006.

- Lydyard, P. M., Whelan, A. and Fanger, M. W. Instant Notes on Immunology, Bios Scientific Publisher Ltd., 2003.

MOLBIO610 – CLINICAL GENETICS

Molecular approach in understanding various inherited disorders: cystic fibrosis, thalassemia, sickle cell anemia, haemophilia, Huntington's chorea, muscular dystrophies, diabetes. Pharmacogenetics, Genetics of cancer, oncogenes, tumor suppresser genes, heritable cancer. In vitro fertilization and embryo transfer. Eugenics: genetic screening, prenatal diagnosis, approaches to linkage polymorphism. Gene therapy and genetic counseling. Detection of carrier and affected individuals in natural population. Detection and calculation of gene frequency of various blood groups.

PRACTICALS

1. Qualitative separation of normal and defective haemoglobins.
2. Detection of carrier and infected individuals in natural population of Inherited disorders.
3. Inherited variation in different isozyme patterns: acid phosphatase; G-6-P-dehydrogenase.
4. Comparative analysis of serum protein in normal and disease individuals: cancer.
5. Detection and calculation of gene frequency of various blood groups.
6. Problem solving on linkage polymorphism.
7. Ascertainment of Mode of inheritance Through Pedigrees
8. Visit to hospitals

RECOMMENDED BOOKS:

- Garland Science/Taylor & Francis. 2003.
- Lewis, R. Human Genetics: concepts and applications. 6th ed. McGraw
- Strechan, T., and A. P. Read, Human Molecular Genetics, 3rd edition,

MOLBIO611 – BIOSAFETY AND BIOETHICS

Definition and history of laboratory acquired blood borne infections. Risk associated with handling human/animal blood, body fluids, tissue samples (including human and animal cell lines). Significant exposure. Risks associated with microbes. The classification of organisms on the basis of hazard. Precautions, prevention and minimizing risks. Vaccination requirements. Post-exposure management. Biosafety in laboratory. Viral vectors. Biosafety rules. Uses and abuses of genetic information. Documentation. Intellectual property rights.

Ethical, moral and religious issues. Reproductive technologies. Artificial insemination; in vitro fertilization (IVF), gamete intrafallopian transfer (GIFT), zygote intrafallopian transfer (ZIFT), surrogacy; drug abuse during pregnancy, involuntary sterilization, induced abortions. Genetic screening, gene therapy, transgenic organisms, agricultural applications. Fetal tissue transplantation; xenografts, AIDS, disclosure, transmission- health care industry, right-to-die transplantation and Xenografting, advance directives, living wills, physician assisted suicide.

RECOMMENDED BOOKS:

- O'Mahony, P.J. Nature, Risk and Responsibilities: Discourses of Biotechnology. Routhledge Publishers. 1999.
- Cutter, S.I. Environmental Risks and Hazards. Prentice Hall. 1993.
- Torrance, I. Bioethics for New Millennium. Saint Andrew Press. 2000.
- Donnellan, C. The Ethics of Genetic Engineering. Independent Educational Publications. 1998.
- Donnellan, C. Cloning (Issues). Independent Educational Publications. 2002.

MOLBIO612 – HUMAN AND ANIMAL BEHAVIOR

Introduction: Understanding Behavior, instinct, learning and memory. Natural Selection and Evolution in development of Behavior, Ingestive Behavior: Drinking: The Nature of Physiological Regulatory Mechanisms; Drinking and Salt Appetite; Brain Mechanisms of Thirst and Salt Appetite; Mechanisms of Satiety. Learning and Memory: Basic Mechanisms: The Nature of Learning; Learning and Synaptic Plasticity; Perceptual Learning; Classical Conditioning; Instrumental Conditioning and Motor Learning. Relational Learning and Amnesia: Human Anterograde Amnesia; Relational Learning in Laboratory Animals. Sleep and Biological Rhythms: A Physiological and

Behavioral Description; Why Do We Sleep; Physiological Mechanisms of Sleep and Waking; Disorders of Sleep; Biological Clocks, clock genes and zeitgebers Reproduction Behavior: Sexual Development; Hormonal Control of Sexual Behavior;

Neural Control of Sexual Behavior; Parental Behavior. Social Organization: Social behavior in animals, mating, fighting, parenting, signaling, social relationship and organization; dominance, territoriality, development of sexes and types, theories of sexual selection and mate choice, mating systems, monogamy, polygamy and polygyny; parental care, social organization and kinship; cooperation; altruism; coalition; optimal foraging theory, foraging alone and in groups. Emotion: Emotions as Response Patterns; Expression and Recognition of Emotions; Feelings of Emotions; Aggressive Behavior. Human Communication: Speech Production and Comprehension: Brain Mechanisms; Disorders of Speech, Reading and Writing. Behavioral disorders in human: Anxiety, depression Physiology of Addiction: Drugs of abuse, addiction, smoking, alcoholism etc.

RECOMMENDED BOOKS:

- Dugatkin, L. A. 2004. Principles of animal behavior. 1st ed. W. W. Norton & Co. Inc. (Recommended Textbook)
- Neil, R. Physiology of Behavior. Allyn and Bacon. 2000.
- Adkins-Regan, E. 2005. Hormones and animal social behavior. Princeton University Press.
- John Alcock. 2010. Animal behavior, an evolutionary approach. 9th Edition. Sinauer Publishers.
- Scott, G. 2009. Essential Animal Behavior. Wiley publishers.
- Drickamer, L. C; Vessey, S. H; Jakob, E. M. 2002. Animal behavior: mechanisms, ecology, evolution. 5th ed. McGraw-Hill Higher Education.
- Sherman, P. W; Alcock, J. (Editors). 2001. Exploring animal behavior. 3rd ed.
- Sinauer Associates, Inc. Huntingford, F. 1984. The study of animal behavior. Chapman and Hall.

MOLBIO613 – TELEMEDICINE AND MEDICAL INFORMATICS SYSTEM

Introduction & Benefits of telemedicine. Communication infrastructure-LAN and WAN technology. Satellite, Mobile, Internet technology for telemedicine. Video and audio conferencing. Medical information storage and management for telemedicine, patient information, medical history, test reports, medical images, diagnosis and treatment. Hospital information systems, Doctors, paramedics, facilities. Pharmaceutical, Security and Confidentiality of medical records and access control. · Cyber laws, Access to health Care Services, Health Education and Self Care. Bio-modeling, medical data coding and compression, Functions of DICOM, PACS and HIS for Telemedicine. History of Patient Record, Introduction to Computer Based Patient Record (CPR), Data from Patients, Coding and Classification, Strategies for Data Entry, Representation of Time and Clinical Use of the CPR, Clinical Departmental and Support Systems. Scope of Hospital Information 61 System (HIS), Challenges for the Health Care Sector, State of Transition, Objectives and Requirements, Planning, Modeling, Development, Architecture and Clinical Uses of HIS. Decision Support Models, Medical Reasoning, Quantitative & Qualitative Methods, Performance & steps involved, Uncertainty in Medical Judgment, Probability Theory and Decision Analysis. Characteristics & Implementing of Decision Support Systems. BM-53

MOLBIO614 – TISSUE CULTURE AND REGENERATIVE MEDICINE

History and application of cell culture. Nutritional requirements, growth and metabolism of cells, serum and growth control, topo-inhibition, source substitutes, pH regulation. Early cell culture, cell types and morphology of cells in culture. Establishment of cell lines. The external surface of cells in culture: chemical composition and biosynthesis of cell membrane. Chemical changes in transformed cell surfaces. Concepts of animal tissue cultures, embryonic stem cell culture, whole organ culture. Biotechnology application in impaired fertility: Superovulation, intra cytoplasmic sperm injection, in vitro fertilization, nuclear transfer techniques. Gene therapy: concepts of gene therapy and its applications in disease states, such cystic fibrosis. Generation of transgenic and knock out models. Different types of stem cells. Stem Cells therapy and its applications in the field of regenerative medicine. Primary and embryonic stem cell culturing using cell lines and animal models. Animal rights and ethics for the use of experimental animals in physiological research. Adults and embryonic stem cells and their regulation Sources of stem cells (adipose, bone marrow, blood etc)

and stem cells Niches. Stem cells and cancer Tissue engineering using stem cells Stem cells as regenerative medicine. Stem cells isolations and culturing. Labeling of stem cells. Transplantation of stem cells.

PACTICALS

1. Culturing of Mammalian Cells (Stem Cells From Wharton's Jelly Of Human Umbilical Cord)
2. Types and strategies of Gene Therapy and Stem Cell Therapy.
3. Types of Fluorescence in-situ Hybridization and its applications.
4. Techniques in Assisted Reproductive Technologies.

RECOMMENDED BOOKS:

1. Cann. A. J (1999). Virus Culture-A Practical Approach. Oxford Univ. Press Inc., New York.

**SEMESTER WISE BREAK-UP OF CREDIT HOURS
FOR MPHIL MOLECULAR BIOLOGY**

SEMESTER 1	Credit Hours
MOLBIO601 - Advances in Molecular Biology	3(3-0)
MOLBIO602 - Genetics & Epigenetics Mechanisms of Gene Regulation	3(2-1)
MOLBIO604 – Biologics	3(3-0)
Optional course (Any 1 course)	3(3-0)
TOTAL CREDIT HOURS	12
SEMESTER 2	
MOLBIO606 - Molecular Biology Research Technique	3(2-1)
MOLBIO603 - Professional responsibilities of Molecular Biologist	3(3-0)
MOLBIO605–Bioinformatics	3(2-1)
Optional course (Any 1 course)	3(3-0)
TOTAL CREDIT HOURS	12
SEMESTER 3 & SEMESTER 4	
Research and Thesis	6 (0-6)
TOTAL CREDIT HOURS	6
GRAND TOTAL (MPHIL PROGRAM)	30

SUMMARY OF THE PLAN OF THE STUDY FOR MPhil MOLECULAR BIOLOGY (SZABMU)

The purpose of this program (MPhil Molecular Biology) is to provide advanced knowledge to students that will train them to decipher the biological processes at molecular level which will prepare them for further research and/or industry.

The development of professional skills through well designed curriculum; based on experiments, training and research. It will also mentor post-graduate students of Molecular Biology for teaching and research in the disciplines of medicine and allied health sciences.

This 2-year program in Molecular Biology will spread over 4-semesters, comprising two semesters of course work and two semesters of research. The students will be required to complete course work having at least 24 credit hours. In addition, there will be 12-credit hours of thesis research. The core courses will comprise 18-credit hours and optional courses 6 credit hours recommended by the supervisory committee of the student concerned.

Presentation/Seminar will be conducted on recent topics in Molecular Biology in consultation with the departmental faculty.

Research Project:

1. Duration of the research project will be at least two regular semesters. An independent research topic chosen by the student and supervised by a full-time faculty member of the department will be a requirement for all students of MPhil Molecular Biology.
2. The research work of each student will be reviewed periodically by the supervisor/head of department to ensure the objectives laid down for study are being met.
3. All students must present and defend their research work before the panel of examiners as per the rules of the university.