COURSE OF STUDIES

for

Master of Philosophy

in

Human Genetics & Molecular Biology

UNIVERSITY OF HEALTH SCIENCES, LAHORE PAKISTAN

Program Rationale:

The rationale of this program is to create new standard of high-quality teaching and research in various areas of basic and clinical Genetics & Molecular Biology and to train students/manpower in modern principles of genetic research and provide an encouraging and stimulating environment to foster learning in the discipline of Human Genetics & Molecular Biology. MPhil in Human Genetics & Molecular Biology offers an interdisciplinary curriculum with the aim to prepare students with advanced knowledge and practical skills necessary for modern biotechnological advancements. Emphasizing both theoretical understanding and hands-on laboratory experience, the program prepares students for diverse career paths in academia, industry, and healthcare. The program will disseminate up-to-date knowledge of Human Genetics & Molecular Biology by organizing journal clubs, seminars and symposia.

Mission Statement:

The purpose of the program for attainment of the award of MPhil in Human Genetics & Molecular Biology aspires to produce qualified manpower for the purpose of teaching, research & service delivery to the profession and public alike. Our degree holders will:

- Serve as geneticists of international standard who will be able to provide pre-eminent diagnostic and technological services and its subspecialties to support patient care.
- Contribute to keep the innovative standards in the health care system of the country in particular and the society at large by continuing professional development and through research in the field.
- Compete successfully for research grants from industry and other sponsoring institutions
- Excel as teachers, researchers and leaders in the specialty.

Program Educational Objectives:

- A graduate in Human Genetics & Molecular Biology must understand the structure and functions of genes, chromosomes and other regulatory molecules for basic and disease research.
- To develop and maintain a well-equipped laboratory with instruments needed for basic and clinical research and to develop interactive research assay protocols to apply theoretical knowledge.
- Students should also be able to read and interpret primary research papers in the area of their study, and give a short “journal club” style presentation on a research paper.
- Be able to use the latest knowledge and modern techniques in the field of clinical and basic research for the benefit of local populations in collaboration with other universities/organizations in the field of medical education.
- Provide graduates with advanced knowledge and understanding of molecular biology and genetics principles, theories, and techniques, enabling them to critically evaluate scientific literature and research in the field.
- Graduates of the department will be able to understand the procedure of Genetic testing and genetic counseling.

Program Learning Outcomes:

- Establishment of a specialized center providing detailed information about the field of study both at basic and clinical level with continuous curriculum update.
- To develop interactive teaching protocols for understanding and disseminating knowledge.
- Giving a heavy weightage to the hands-on training through advanced laboratory exercises and use of sensitive and complex technologies for increasing student’s competency.

- To promote collaborative studies where the use of expertise at both ends will help to solve the common clinical and research problems pertaining to genetic diseases and molecular pathology of cancers and genetic counseling for the benefit of local population.
- Graduates of the department will be able to understand and perform Genetic testing and genetic counseling.

SCHEME OF STUDIES (2-Year)

MPhil: Human Genetics & Molecular Biology

Semester #	Course code	Course title	Credit hours		
			Theory	Practical	Total
1		Biostatistics and Research Methodology	2	0	2
	HGMB 701	Basic Cell Biology	2	1	8
	HGMB 702	Basic Molecular Biology and Genetics	3	0	
	HGMB 703	Laboratory Techniques in Molecular Biology and Cytogenetics	1	1	
		Gene Therapy (708), Essential of Bioinformatics (709), Recombinant DNA and Biotechnology (710), Molecular Oncology (711)	2	0	2
2	HGMB 704	Population Genetics	2	0	8
	HGMB 705	Genetics of Immunity and Cancer	2	0	
	HGMB 706	Genetic Technology	1	1	
	HGMB 707	DNA Mutations and Chromosomes	2	0	
		Gene Therapy (HGMB 708), Essential of Bioinformatics (HGMB 709), Recombinant DNA and Biotechnology (HGMB 710), Molecular Oncology (711)	2	0	2
3	Research (thesis)		6		6
4	Professional & Teaching Skills Apprenticeship (PTSA)		0		2
					(Total: 30)

Course Title: Basic Cell Biology

Contact Hours:	**Credit Hours:**
Theory = 32	**Theory =** 2
Practical = 48	**Practical =** 1
Total = 80	**Total =** 3

Course Objective:

Through completion of this course, students will

- Explore the basic structure & function of cells and various.
- Understand the processes of cell division and cell death (apoptosis), crucial for growth, repair, and maintenance of tissues.
- Examine unique properties of stem cells and their potential applications in medicine and research.
- Investigate the diverse community of microorganisms that inhabit the human body and their impact on health and disease.
- Study the anatomy and physiology of the male and female reproductive systems and explore the process of meiosis.

Learning Outcome:

After completion of this course, student will be able to

- Identify the fundamental components of a cell, including organelles, membranes, and cytoskeletal elements.
- Describe the functions of key cellular structures, such as the nucleus, mitochondria, endoplasmic reticulum, and Golgi apparatus.

- Understand the processes of cell division and cell death (apoptosis), and explain the stages of the cell cycle, including interphase, mitosis, and cytokinesis.
- Define the characteristics of stem cells, and assess the therapeutic potential of stem cells in disease treatment.
- Describe and analyze the interactions between the human microbiota and the immune system, and their implications for health.
- Investigate the process of meiosis and its significance in generating genetic diversity and producing haploid gametes for sexual reproduction.

Course Outline:

The cells, introducing cells, eukaryotic and prokaryotic cells, cell components/organelles, extracellular structure and their role, origin of eukaryotic cells, cell division: cell cycle, mitosis, cell cycle regulation, cell death, how does unregulated cell division leads to cancer, stem cells, basic characteristics, human microbiome, reproductive system, gametes maturation, prenatal development, birth defects, maturation and aging

Practicals

- Microscopy
- Cell counting
- Karyotyping
- Conventional PCR

Recommended Books:

- Human Genetics: Concepts and Applications by Ricki Lewis (11th Edition)
- Molecular Biology of the Cell by Bruce Alberts (6th edition)

- Molecular Biology of the Gene by James D. Watson (6th edition)
- Life: The Science of Biology (10th Edition). Sadava, Hillis, Heller, BerenBaum. MacMillan.

Course Title: Basic Molecular Biology and Genetics

Contact Hours:

Theory = 48

Practical = 0

Total = 48

Credit Hours:

Theory = 3

Practical = 0

Total = 3

Course Objective

This course has been designed to provide students with a basic understanding of essential concepts and techniques in molecular biology and genetics. The students will explore the structure and function of DNA and the processes of DNA replication, flow of genetic information from DNA to protein, including transcription, post-transcriptional processing of RNA, translation, and protein processing. The course will enable the students to examine patterns of inheritance, including single-gene inheritance, pedigree analysis, and deviations from Mendelian inheritance patterns. They will learn about genetic variation, inheritance patterns, and the regulation of gene expression.

Learning Outcomes:

After completion of this course, student will be able to

- Explain the experiments that led to the identification of DNA as the genetic material, and describe the structure of DNA, process of DNA replication, transcription, post transcriptional processing of RNA.
- Understand the process of translation and the role of ribosomes, tRNA, and mRNA in protein synthesis and describe the post-translational modifications involved in protein processing

- Discuss the mechanisms involved in regulating gene expression such as DNA methylation, histone modifications, and non-coding RNAs in controlling gene expression.
- Explain the principles of single-gene inheritance, perform pedigree analysis, investigate the cases where gene expression deviates from Mendelian ratios
- Understand the inheritance patterns of traits influenced by sex chromosomes, including sex-limited and sex-influenced traits, and the process of X chromosome inactivation.

Course Outline:

DNA structure and replication: Experiments to identify and describe the genetic material, DNA structure, DNA replication, Maintaining the genetic information, sequencing of DNA. Gene action: from DNA to protein: Transcription, post transcriptional processing of RNA, Translation of a protein, Processing of a protein. Control of gene expression and epigenetics: Gene expression through time and tissue, control of gene expression, maximizing genetic information, non-coding regions of human genome, Single gene inheritance: Inheritance of one gene, single-gene inheritance is rare, following the inheritance of more than one gene, pedigree analysis, Beyond Mendel's Laws: When gene expression appears to alter mendelian ratios, mitochondrial genes, linkage, Matters of Sex: traits inherited on sex chromosomes, sex-limited and sex-influenced traits, X inactivation, parent-of-origin effects

Practicals:

NA

Recommended Books:

- Human Genetics: Concepts and Applications by Ricki Lewis (11th Edition)
- Molecular Biology of the Cell by Bruce Alberts (6th edition)
- Molecular Biology of the Gene by James D. Watson (6th edition)

- Life: The Science of Biology (10th Edition). Sadava, Hillis, Heller, BerenBaum. MacMillan.

Course Title: Laboratory Techniques in Molecular Biology and Cytogenetics

Contact Hours:	**Credit Hours:**
Theory = 16	**Theory =** 1
Practical = 48	**Practical =** 1
Total = 64	**Total =** 2

Course Objective

This course is designed as an upper-level laboratory course in molecular biology and human genetics. The laboratory course will be an intensive exposure to the principles and techniques used in molecular biology and genetics starting with good laboratory practices and going on with DNA/RNA/plasmid isolation, agarose/polyacrylamide gel electrophoresis, basic bioinformatics analyses, polymerase chain reaction (PCR), SNP genotyping assays, DNA sequencing, and cytogenetics, thus enabling students to learn the safest use of molecular biology lab equipment and reagents, and rigorously interpret and analyze results. The emphasis of the laboratory and lectures complement what is done in the laboratory.

Course Outcomes

After completion of this course, student will be able to

- Demonstrate a clear understanding of good laboratory practices, ensuring the safe and efficient use of molecular biology laboratory equipment and reagents.

- Learn skills of essential laboratory techniques used in molecular biology and genetics, including DNA/RNA/plasmid isolation, agarose/polyacrylamide gel electrophoresis, PCR, SNP genotyping assays, DNA sequencing, and cytogenetics.
- Students will develop the ability to interpret and analyze experimental results obtained from laboratory techniques to draw meaningful conclusions.
- Students will gain hands-on experience with basic bioinformatics analyses, allowing them to analyze and interpret biological data using computational tools and databases.

Course Outline:

Laboratory health and safety, lab math and reagent preparation, nucleic acid isolation and quantification, agarose and polyacrylamide gel electrophoresis, basic bioinformatics analyses including primer designing, conventional PCR, quantitative/Real-time PCR, basic and advanced SNP genotyping, DNA sequencing, karyotyping, cytogenetics, karyotyping and fluorescence in situ hybridization (FISH)

Practicals:

- Isolation of RNA from different sources
- Isolation of genomic DNA from different tissues
- qPCR
- Use of biological databases
- DNA sequencing

Suggested Readings:

- WHO Biosafety Laboratory Manual (4th Edition)
- Calculations for Molecular Biology and Biotechnology (2nd Edition)
- Methods in Molecular Biology, CSH and Springer protocols
- Updated Internet sources
- Life: The Science of Biology (10th Edition). Sadava, Hillis, Heller, BerenBaum. MacMillan.

Course Title: Population Genetics

Contact Hours:	**Credit Hours:**
Theory = 32	**Theory =** 2
Practical = 0	**Practical =** 0
Total = 32	**Total =** 2

Course Objective:

Through this course, students will learn basic principles and concepts of population genetics, and human evolution and their forensic as well as medical applications. The course will provide students with a comprehensive understanding of population genetics principles and their role in evolutionary processes. The course will also examine the evolutionary history of the human species, including human origins, peopling of the planet, and the genetic and molecular evidence supporting our understanding of human ancestry.

Course Outcomes:

After completion of this course, student will be able to

- To apply population genetics principles, such as Hardy-Weinberg equilibrium, to analyze genetic data and predict allele frequencies within populations.
- Understand how various evolutionary forces, including natural selection, genetic drift, mutation, and migration, shape allele frequencies over time.
- Demonstrate a thorough understanding of human evolutionary history and the genetic evidence supporting hypotheses related to human origins and peopling of the planet.

Course Outline:

Constant allele frequencies, population genetics underlies evolution, constant allele frequencies, applying Hardy-Weinberg equilibrium, DNA profiling using Hardy-Weinberg assumptions, changing allele frequencies, nonrandom mating, migration, genetic grift, mutations, natural selection, eugenics, human ancestry and evolution, human origins, methods to study molecular evolution, peopling of the planet, what makes us human?

Suggested Readings:

1. Human Genetics: Concepts and Applications by Ricki Lewis (11th Edition)
2. Genetics in Medicine by Thompson & Thompson (8th edition)
3. Molecular Biology of the Gene by James D. Watson (6th edition)

Course Title: Genetics of Immunity and Cancer

Contact Hours:	**Credit Hours:**
Theory = 32	**Theory =** 2
Practical = 0	**Practical =** 0
Total = 32	**Total =** 2

Learning Objective:

This course has been designed to introduce students the essential concepts in genetics of immunity including components/responses of immune system, use of genetic technologies to manipulate immunity in prevention/treatment of diseases and infections. In addition, the course enables students to understand genetics of cancer including carcinogenesis, cancer genes and molecular biomarkers/therapeutics in diagnosis and treatment of cancers, with applications in human health and disease.

Course Outcomes:

After completion of the course, students will be able to

- Explain the genetic basis of the immune response, the significance of cell surface proteins, and the overall function of the human immune system.
- Identify the genetic and environmental factors contributing to autoimmune diseases, immunodeficiencies, and cancer, including the processes of tumor initiation and progression.
- Apply genomic technologies to understand and combat infectious diseases and cancer, discussing the role of genomics in diagnosis, treatment, and personalized medicine.
- Evaluate the challenges in diagnosing and treating cancer, considering genetic heterogeneity, resistance mechanisms, and the development of targeted therapies.

Course Outline:

Genetics of Immunity, the importance of cell surfaces, human immune system, abnormal immunity, alternating immunity, using genomics to fight infection, cancer

genetics and genomics, cancer as an abnormal growth that invades and spreads, cancer at the cellular level, cancer genes and genomes, challenges of diagnosing and treating cancer.

Practicals:

NA

Suggested Readings:

1. Human Genetics: Concepts and Applications by Ricki Lewis (11th Edition)
2. Genetics in Medicine by Thompson & Thompson (8th edition)
3. Molecular Biology of the Gene by James D. Watson (6th edition)
4. Life: The Science of Biology (10th Edition). Sadava, Hillis, Heller, BerenBaum. MacMillan.

Course Title: Genetic Technology

Contact Hours:	**Credit Hours:**
Theory = 16	**Theory =** 1
Practical= 48	**Practical=** 1
Total= 64	**Total=** 2

Course Objective

This course will help equip the students with comprehensive understanding of contemporary issues and technologies in genetics and genomics. Student will also explore different genetic tools and technologies and their use in pharmaceuticals and biotechnology industry, diagnosis and treatment of genetic disorders. The course will also help the students to learn assisted reproduction technologies, genome analysis and editing.

Course Outcomes:

After completion of the course, students will be able to

- Gain a understanding of the important technologies in genetics and genomics.
- Apply the genetic tools and technologies used in the pharmaceutical and biotechnology industries, as well as in the diagnosis and treatment of genetic disorders.
- Learn and understand assisted reproductive technologies, genome analysis, and genome editing techniques.

Course Outline

Patenting DNA, modifying DNA, monitoring gene function, gene silencing and genome editing, genetic testing and treatment, genetic counseling, genetic testing, treating genetic diseases, reproductive technologies, savior siblings and more, infertility and subfertility, assisted reproductive technologies, extra embryos, Genomics, from genetics to genomics, analysis of the human genome, personal genomic sequencing

Practicals

- Karyotyping
- Pedigree analysis
- Genetic problems of Probability
- Conventional PCR
- Mutational Analysis

Suggested Readings:

1. Human Genetics: Concepts and Applications by Ricki Lewis (11th Edition)
2. Genetics in Medicine by Thompson & Thompson (8th edition)
3. Molecular Biology of the Gene by James D. Watson (6th edition)

Course Title: DNA Mutations and Chromosomes

Contact Hours:	**Credit Hours:**
Theory= 32	**Theory=** 2
Practical= 0	**Practical=** 0
Total= 32	**Total=** 2

Course Objective:

This course will help the students in understanding the details of mutations and chromosomes. The course will provide knowledge about the structure of chromosomes, their detection and also the issues related to atypical chromosome number and structure. Furthermore, this course will learn about the nature, causes, and types of gene mutations, significance of mutation positions and the concept of allelic disorders.

Course Outcomes:

Through the completion of this course, students will be able to

- Get a detailed and inclusive understanding of mutations and chromosomes, including their structures, detection methods, and issues related to atypical chromosome number and structure.
- Learn about the nature, causes, and types of gene mutations, as well as the significance of mutation positions and the concept of allelic disorders.

Course Outline:

Chromosomes: Portrait of a chromosome, detecting chromosomes, atypical chromosome number, atypical chromosome structure, uniparental disomy, gene

mutation: nature of mutations, allelic disorders, causes of mutation, types of mutations, importance of position, DNA repair

Suggested Readings

- Human Genetics: Concepts and Applications by Ricki Lewis (11th Edition)
- Genetics in Medicine by Thompson & Thompson (8th edition)
- Molecular Biology of the Gene by James D. Watson (6th edition)
- Molecular Biology of the Cell by Bruce Alberts (6th edition)

Course Title: Gene Therapy

Contact Hours:	**Credit Hours:**
Theory= 32	**Theory=** 2
Practical= 0	**Practical=** 0
Total= 32	**Total=** 2

Course Objectives:

The gene therapy course will provide students a comprehensive understanding of the gene therapy. The students will learn about the structure and function of gene as well as various gene delivery systems, including both viral and non-viral methods. The course will impart knowledge about distinctions between ex vivo and in vivo gene therapy, gene augmentation, targeted cell killing, inhibition of gene expression, and correction of gene mutations. Additionally, students will learn about genome editing techniques like gene knockout, knockdown, and gene knock-in. The course will also address the applications of gene therapy for various diseases.

Course Outcomes:

Upon completion of this course, students will be able to

- Describe gene therapy as a novel treatment option for genetics diseases.
- Explain various gene delivery systems in cells and d, and understand the differences between ex vivo and in vivo gene therapy
- Explain different types of gene therapy, such as gene augmentation, targeted cell killing, inhibition of gene expression, and gene mutation correction
- Understand genome editing techniques, including gene knockout, knockdown, and gene knock-in

Course Outline:

An introduction to gene therapy: definition and basic concepts, Gene structure and function, Gene delivery systems, Types of gene therapy: gene augmentation therapy, targeted killing of specific cells, targeted inhibition of gene expression, targeted gene mutation correction, Gene therapy strategies: Gene therapy approaches, including classical and non-classical methods, methods of gene therapy, such as ex vivo and in vivo gene therapy, Target sites for gene therapy, Gene delivery methods, viral and non-viral methods, Genome editing techniques: gene knockout, gene knockdown, siRNA, Gene Knock in. applications and issues of stem cells and gene therapy

Practicals:

NA

Suggested Readings

1. Bio Technology – Genetic Engineering & Applications. NPTEL – Bio Technology
2. Updated internet sources
3. A guide to human gene therapy by Ronald W Herzog & Sergei Zolotukhin

Course Title: Essentials of Bioinformatics

Contact Hours:	**Credit Hours:**
Theory= 16	**Theory=** 1
Practical= 48	**Practical=** 1
Total= 2	**Total=** 2

Course Objective:

After successful completion of this course, students will be expected to explore basic concepts of bioinformatics, data and database searching, data mining, and literature search using EndNote. This course covers essential molecular biology and genetic databases, including NCBI, Ensembl, UCSC Genome Browser, and dbSNP and provide hands-on training in bioinformatics tools for PCR and genotyping, such as primer designing, RFLP assay design with NEB cutter, allele-specific PCR, and ARMS assays. Course also emphasis on homology and sequence alignments, with detailed instruction on BLAST, pairwise and multiple sequence alignments, and the use of Clustal W.

Course Outcomes:

After completion of this course student will be able to

- Efficiently use different databases concerning molecular biology and genetics research for data mining purposes
- Demonstrate effective utilization of various in silico tools for different assay designs in PCR, homology detection and phylogenetic analysis
- Comprehend knowledge of resources available for viewing protein structure, and build skills in visualizing and modelling of 3D protein structures, especially in context of genetic mutational analysis

Course Outline:

Introduction to bioinformatics: Basic concepts and applications of bioinformatics. Data and Database searching (with hands on training), Introduction to data mining and databases, Literature search and citation management using EndNote, Essential Molecular biology and Genetic databases, Use of NCBI, Ensembl, UCSC genome Browser, dbSNP and other databases. Bioinformatics tools in PCR and Genotyping (with hands on training), Primer designing for PCR, Assay design in RFLP and use of NEB cutter, assay design in allele specific PCR, assay design in ARMS, Homology, Sequence Alignments and BLAST (with hands on training): Introduction to BLAST and its types, Pairwise sequence alignments with special emphasis on DNA sequencing analysis, Multiple sequence alignment (MSA) and use of Clustal W program, Phylogenetic analysis (with hands on training), Molecular phylogeny and evolution, Phylogenetic trees and their types, Phylogenetic tree construction, analysis and use of MEGA5 software, Bioinformatics analysis of genetic mutations and Protein structure predictions (with hands on training), Introduction to protein structures and domains, Visualization of protein 3D structures, Protein structure prediction, Analysis of predicted 3D structures of proteins, Analysis of Missense variants, Analysis of frameshift variants.

Practicals

- Primer designing for PCR
- Assay design in RFLP
- Use of NEBcutter
- Assay design in allele specific PCR
- Use of NCBI, Ensembl, UCSC genome Browser, dbSNP

Suggested Readings

- JIN XIONG. 2006, Essential Bioinformatics., Texas A&M University, Cambridge University Press
- Mark Gerstein, 1999, Yale, bioinfo.mbb.yale.edu
- http://www.ncbi.nlm.nih.gov/bookshelf/br.fcgi?book=handbook
- http://www.ebi.ac.uk/, http://www.expasy.ch/doc.html

- Various other online resources and different in silico tools will be indicated for each module

Course Title: Recombinant DNA and Biotechnology

Contact Hours:	**Credit Hours:**
Theory= 32	**Theory=** 2
Practical= 0	**Practical=** 0
Total= 32	**Total=** 2

Course Objectives:

In this course " Recombinant DNA and Biotechnology" students will learn about the methods for inserting genes into the cells and the roles of various enzymes used in DNA manipulation. The students will explore the molecular tools of recombinant DNA technology, including restriction endonucleases and various cloning vectors (plasmids, bacteriophages, cosmids, phagemids, YACs, and BACs). Students will learn about reporter genes, sources of DNA for cloning, and the construction of genomic libraries. Additionally, the course will address gene expression in different biological systems, the creation of DNA mutations in the laboratory, gene inactivation via homologous recombination, and the use of complementary RNA to inhibit gene expression. DNA microarrays and their role in revealing RNA expression patterns will be discussed. The course will also examine how expression vectors can turn cells into protein factories and explore the broader impacts of biotechnology on medicine and agriculture, along with public concerns regarding biotechnology.

Course Outcomes:

Upon completing the course, students will be able to

- Understand the principles of recombinant DNA technology and biotechnology and show proficiency in using enzymes for DNA manipulation, including DNA polymerases, nucleases, ligases, and modification enzymes.
- Utilize molecular tools such as restriction endonucleases in cloning and other biotechnological processes and be able to use various cloning vectors (plasmids, bacteriophages, cosmids, phagemids, YACs, BACs.
- Describe appropriate prokaryotic and eukaryotic host organisms in recombinant DNA experiments, construct and screen genomic libraries for gene cloning.
- Use RNA interference techniques, DNA microarrays etc.
- Discuss applications in biotechnology is applied in medicine and agriculture and address public concerns about biotechnological advancements.

Course Outline:

An introduction to recombinant DNA and biotechnology, methods to insert genes into Cells, Enzymes for DNA manipulation: DNA polymerases, Nucleases, DNA ligases, modification enzymes, Molecular Tools of Recombinant DNA Technology: Restriction endonucleases, Cloning vehicles: Vectors (plasmids, Bacteriophages, cosmids, phagemids, YAC and BAC), Expression and cloning vectors, Host organisms (Prokaryotic Hosts, Eukaryotic Hosts), reporter genes, sources of DNA used for cloning, constructing genomic libraries, Genes can be expressed in different biological systems, DNA mutations can be created in the laboratory, Genes can be inactivated by homologous recombination, Complementary RNA can prevent the expression of specific genes, DNA microarrays reveal RNA expression patterns. What Is biotechnology? Expression vectors can turn cells into protein factories, How Is biotechnology changing medicine and agriculture? public concern about biotechnology

Practicals:

NA

Suggested Readings

1. Life: The Science of Biology (10th Edition). Sadava, Hillis, Heller, BerenBaum. MacMillan.

2. Gene cloning and DNA Analysis: An Introduction (8th Edition) by TA Brown

Course Title: Molecular Oncology

Contact Hours:	**Credit Hours:**
Theory= 32	**Theory=** 2
Practical= 0	**Practical=** 0
Total= 32	**Total=** 2

Course Objectives:

In this course "Molecular Oncology" students will learn about the basis of cancer cell transformation, changes at molecular levels and implications in diagnosis and therapeutic.

Course Outcomes:

Upon completing the course, students will be able to

- Understand the principles of cancer cell transformation including phenotypic and genetic changes including molecular alterations and related functional aspects.
- Correlate the molecular changes with the disease progression and its implications in diagnostic and therapeutic aspects.

Course Outline:

Introduction to cancer, Hallmarks of cancer, Classification and epidemiology, Causes of cancers (Carcinogens and viruses), Tumor initiation and progression, Phenotypic changes in transformed cells, Molecular basis of de-regulated mechanisms, Cell cycle, Apoptosis, Angiogenesis and Proliferation in cancers, Role of growth factors, Signaling pathways in cancers, Biology of Tumor metastasis, Genetic alterations in cancers,

Structural and numerical changes in chromosomes, Tumor suppressors and Oncogenes, Molecular basis of cancer diagnosis and Therapeutics.

Practical:

NA

Suggested Readings

1. Cancer Biology. Raymond W. Ruddon. Oxford University Press.
2. Molecular Biology of Cancer, Mechanism, Targets and Therapeutics, (3rd Edition), Lauren Pecorino

Course Title: Professional & Teaching Skills Apprenticeship (PTSA)

Contact Hours: 96	**Credit Hours:** 2
Theory= 0	**Theory=** 0
Practical= 0	**Practical=** 0
Total= 0	**Total=** 0

Course Outline/Practicals

Hands-on training in

- RNA isolation,
- Genomic DNA isolation
- cDNA synthesis
- Primer designing
- Conventional PCR

- Gel electrophoresis
- Real time PCR