Course Outline and TOS for M.Phil (MLSc) Molecular Pathology and Cytogenetics [Major paper 1 & 2]

Paper 1

Topics	MCQs	SEQs
Nucleic Acid	**10**	**2**
DNA structure		
DNA replication		
RNA structure and types		
RNA transcription and Gene expression	**8**	
RNA processing		
Translation and Post-translational processing		
Extraction and concentration of Nucleic Acid	**3**	**1**
DNA Extraction from Blood		
DNA Extraction from Tissue		
DNA Extraction from Saliva		
Extraction of DNA from Microdissected Archival Tissues		
DNA Extraction from Plasma and Serum		
DNA Extraction from Fungi, Yeast, and Bacteria		
Extraction of Ancient DNA		
RNA Extraction from Blood	**3**	
RNA Extraction from Frozen Tissue		
RNA Extraction from Tissue Sections		
Dual DNA/RNA Extraction		
Isolation of RNA Viruses from Biological Materials		
DNA Sequencing	**6**	
DNA sequencing by Dideoxy (Sanger) Method		
DNA sequencing by Chemical (Maxam-Gilbert) Method		
Denaturing Gel Electrophoresis for Sequencing		
Next Generation Sequencing		
Emerging Sequencing Techniques		

Volume/Weight measurement		
Volume measurement		
Weight measurement		
Concentration measurement		
Spectrophotometry	**4**	
Principles of spectrophotometry		
Component of spectrophotometer		
Understanding results		
Trouble shooting		
Quantification of Nucleic acid		**1**
Quantification of Proteins	**4**	
Gel based quantification of Proteins and Nucleic acid		
Equipping and Establishing a PCR Laboratory		
Reagent Preparation		
Accuracy of weighing and Pipetting	**4**	
Use of calibrated pH meter		
Avoiding contamination of reagents		
Making buffer solutions		
Polymerase Chain Reaction		
Basics of PCR/Principles of PCR		
Thermal Cycler machine		
Primer Designing		
Reagent preparation	**10**	
dNTP stock		**1**
PCR reaction buffer		
Primer dilution		
Optimization of PCR cycling condition		
Different PCR techniques & Applications	**6**	
Contamination control and Trouble shooting		

Real Time PCR	**10**	**1**
Principles of RT PCR		
RNA isolation		
cDNA generation		
Primer designing		
Probes designing		
Fluorescent dyes for monitoring real time amplification	**6**	
Nested RT-PCR		
Real time PCR analysis & quantification		
Applications of RT PCR		
Electrophoresis	**6**	**1**
Agarose gel electrophoresis		
SDS-Polyacrylamide Gel electrophoresis (SDS-Page)		
Staining protein gels		
Digital electrophoresis analysis		
Other electrophoresis techniques		

Paper 2

Topics	MCQs	SEQs
Human Genome	**6**	**1**
Organization of Human Genome		
Genetic code		
DNA variations and Mutations		
Mode of Inheritance	**8**	
Mendalian Mode of Inheritance		
Complications of the basic mendalian pattern		
Multifactorial mode of inheritance		
Pedigree construction		
Hardy Weinberg Equation and Factors affecting the gene frequencies		
Nucleic Acid Hybridization	**6**	**1**
Principles of Hybridization		
Southern blotting		
Northern blotting		
Immunoblotting/Dot and Slot Blotting		
Labelling DNA and preparing probes	**4**	
Microarray based hybridization		
FISH & ISH		
Other techniques of blotting		
DNA Libraries	**6**	**1**
Enzymatic Manipulation of DNA and RNA/Restriction Fragment Length Polymorphism		
Genetic Mapping of Mendelian Characters		
Mapping Genes Conferring Susceptibility to Complex Diseases		
Association Studies and Linkage disequilibrium		
Identifying Human Disease Genes and Susceptibility Factors	**6**	
Positional Cloning		
Candidate Gene Approach		

Positional Independent Routes to Identifying Disease Genes		
Genome wide Association studies		
Emerging Molecular techniques		
Single Nucleotide Polymorphism analysis		
Restriction Length polymorphism analysis		
Current and Emerging Techniques for Diagnostic Mutation Detection	**6**	
Molecular diagnosis of infectious and parasitic diseases		
Pre-natal and Pre-implantation Genetic Diagnosis		
Chromotography		
Cancer Genetics		
Oncogenes	**6**	
Proto-oncogenes		
Cell cycle dysregulation in Cancer		**1**
Fusion genes		
Molecular Markers of Angiogenesis and tumorgenesis	**4**	
Molecular technique used in cancer diagnosis		
CYTOGENETICS		
Introduction to Cytogenetics and the objectives of a clinical cytogenetics services.	**6**	
Chromosome structure and functions		
ISCN(International System for Human Cytogenetic Nomenclature) of G-banded chromosomes		
Preparation of Human Tissues for Cytogenetics studies		**2**
Peripheral blood cell culture and harvesting techniques		
Bone Marrow cell culture and harvesting techniques	**6**	
Solid organs cell culture and harvesting techniques		
Amniotic Fluid and Chorionic villi sample culturing techniques		

Chromosome slide making techniques	**6**	**1**
G-banding of Chromosomes		
Other banding techniques		
Molecular Cytogenetics	**6**	
Fluorescence in Situ Hybridization principles and techniques		
Principles of Comparative Genome Hybridization		
Principles of Microarray technique		
Use of database and Computer Assisted Analysis/Image Reproduction	**4**	
Trouble shooting and laboratory management		

Reference Books

1 Watson, J.D., Gann, A., Levine, M., Losicks, R., 7th Edition (2014). Molecular Biology of the Gene. Cold Spring Harbor Laboratory Press, New York

2 Cox, M., Doudna J., Donnell, M., 2nd Edition (2015). Molecular Biology, Principals and Practice. W. H. Freeman & Comp. New York.

3 Lewis, R., 9th and 10th Edition. Human Genetics. McGraw Hills

4 Gallagher, S., Wiley, E., (2008). Current Protocols Essential Laboratory Techniques, Emily A. Wiley, New Jersy.

5 Pecorino, L. (2012). Molecular Biology of Cancer: Mechanisms, Targets and Therapeutics. 3rd Edition. Oxford University Press, Great Clarendon Street, United Kingdom

6 Czepulkowski, B. (2000). Analyzing Chromosomes. London: BIOS Scientific Publishers.

7 Ram, M. (2010). Fundamentals of cytogenetics and genetics. New Delhi: PHI Learning Private Limited.