

Cellular and Molecular Diagnostics

THEORY

Module 1: Cell Biology and Diagnostics

Subject code CMD 601

Cell Biology and Diagnostics

40 hours

Atomic bonds and Molecular interactions; Small organic molecules, Macromolecules; Compartmentalization of cells: transport of molecules between nucleus and cytosol, Transport of proteins into mitochondria and chloroplasts, Endoplasmic Reticulum; General principles of cell communication: Signalling - Extracellular, Intracellular, Autocrine, Signaling through G-protein-linked cell surface receptors, Signaling through enzyme-linked cell surface receptors, Signaling pathways that depend on regulated proteolysis; Cell Cycle; DNA repair pathways and methods of detection – Flow cytometry

Module 2: Genetics and Diagnostics

Subject code CMD 603

Genetics and Diagnostics

40 hours

Origin and direction of human cytogenetics; General features of chromosomes, Chemistry and packaging of chromosomes, Chromosome bands, banding techniques and their molecular correlates; Structural and numerical abnormalities of chromosomes and their causes, Sex determination and differentiation, Y chromosome evolution and variations and X-inactivation mechanism and phenotypic effects of sex chromosome imbalances, Fragile sites, Trinucleotide repeat expansion, mechanism and associated disorders, Genomic imprinting and their disorders; Fluorescence *In situ* hybridization, chromosome Comparative Genomic Hybridization arrays; Genetic linkage and chromosome and genetic mapping in human diseases.

Module 3: Biochemistry in Diagnostics and Molecular Biology

Subject code CMD 605

Biochemistry in Diagnostics

20 hours

Proteins and Amino acids, Qualitative and quantitative techniques: Protein stability, denaturation; amino acid sequence analysis; Metabolism of lipids, carbohydrates, amino acids;

In-born errors of metabolism; energy requirements, nutritional disorders; vitamins & minerals - biochemical function and deficiency manifestation

Molecular Biology

20 hours

Nucleic acid extraction – principle and methods; Polymerase Chain Reaction – principle, types (including RT-PCR, real-time PCR, QF-PCR) and applications; DNA sequencing methods – principle, types, automated process, DNA sequencers; Hybridization techniques – Southern, Northern, in-situ (including FISH), microarrays – types and applications; Protein extraction and analysis (including PAGE and its variations); Western Blot

Module 4: Immunodiagnosics, drug delivery, GLP and GMP

Subject code CMD 607

Immunodiagnosics

15 hours

Introduction, antigen-antibody binding interactions and assays; Immunoassays – types [RIA, ELISA, ChemiluminescentIA, FIA] and specific applications; Immunohistochemistry – principle and techniques

Drug delivery

15 hours

Various drug delivery systems, targeting potentials; systems used for delivery of biotechnological products (Liposomes, microspheres, nanoparticles, immobilization techniques, etc.)

GLP and GMP

10 hours

Awareness, Documentation requirements

Data Analysis and Communication Skills

PRACTICALS

16 hours/week

Cellular Diagnostics

1. Karyotype using Human lymphocyte culture
 - a. Q-banding
 - b. G-banding
 - c. C-banding
 - d. NOR-banding
 - e. R-banding
2. Study of Chromosomal Aberrations in Mice
3. Meiotic Chromosome preparations from testis
4. Fluorescence in situ Hybridization
5. Bone marrow micronuclei test from Mice
6. Mitotic chromosome preparation from Bone marrow of Mice and cultured Lymphocytes
7. SCE analysis;
8. Automated Karyotyping
9. High resolution of banding chromosomes
10. Chromosomal preparation from mouse bone marrow
11. Micronucleus assay – bone marrow of mouse and cultured lymphocytes
12. Mouse sperm – morphology and other characteristics
13. Flowcytometry.
14. Human/Mouse – Cell hybridization

Molecular Diagnostics

1. Isolation of genomic DNA from peripheral blood.
2. Agarose gel electrophoresis
3. Southern hybridization
4. Preparation of competent cells and transformation
 - a. CaCl_2 method
 - b. Electroporation
5. Plasmid preparation.
6. Construction of recombination DNA and Cloning
7. RNA isolation (from rat liver)
8. Pulsed Field Gel Electrophoresis
9. PAGE and Western Blot
10. DNA sequencing
11. Determinations of DNA Quality & Concentration by spectrophotometry
12. Purification of Plasmid
13. Automated DNA Sequencing
14. PCR
15. Mutation detection methods
16. Functional protein identification

17. Mass Spectroscopy and its applications
18. SSCP
19. Denaturing gradient gels
20. Temperature gradient gels
21. PCR amplification using primers that amplify the regions consisting of dinucleotide repeats, trinucleotide repeats and that detects restriction enzyme polymorphic sites, Alu ins/del sites.
22. Creation of transgenic mice mutants for specific genes – use in biomedical research
23. Forensic applications
24. Paternity testing
25. Victim identification
26. Crime detection
27. Individual identification
28. QF-PCR
29. ELISA