

## PAPER-IV. MOLECULAR BIOLOGY

Proposed	Hours
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**GOALS:** To understand the cell biology & genetics that forms the basis for new drug discovery.

**OBJECTIVES:** Upon completion of the course, the candidate is expected to know basic cell biology. Recombinant DNA technology, transfer of genes to mammalian cells.

### COURSE DESCRIPTION

#### **THEORY**

1. **Cellular structure and functions: (8 hours)**
  - a. **Cell structure:** cell wall, cytoplasm and its components, nucleus and its components
  - b. **Plasma membrane:** Structure, transport of small molecules and drugs across it, endocytosis, transport proteins and their inhibitors
  - c. **Extra cellular matrix, cell signaling and communication** between cells and their environment, ion-channels, Organization of signal transduction pathways, third messengers,
  - d. Biosensors-introduction and applications.
2. **Mechanisms of Cellular Regulation: (10 hours)**
  - a. **Excitation, contraction and secretion**
  - b. **Cell proliferation:** Phases and checkpoints of Cell cycle, Positive and negative regulators of cell cycle
  - c. **Cell renewal:** Stem cells and maintenance of adult tissues, proliferation of different stem cells, medical application of adult stem cells, embryonic stem cells, somatic cell nuclear transfer, induced pluripotent stem cells and their therapeutic applications in medicine.
  - d. **Cell death (Apoptosis):** Events of apoptosis, regulators of apoptosis, intrinsic and death pathways of apoptosis.
  - e. Animal cell culture
3. **Gene manipulation and its applications (32 hours)**
  - a. Role of genes within cells, DNA- the primary genetic material, Elucidation of genetic code, Gene expression, Genetic elements that control gene expression, microarray. (5 hrs)
  - b. Recombinant DNA Technology: Principles, process and applications. Gene cloning: Isolation, cloning vectors, enzymes used in molecular cloning, PCR (Polymerase chain reaction), LCR (Ligation chain reaction) and their applications. The formation and uses of RFLP's (Restriction Fragment Length Polymorphism). (8 hrs)
  - c. Recombinant DNA / Human Genetics: DNA sequencing, Mapping and cloning of Human disease genes, DNA-Based diagnosis of genetic diseases. (4 hrs)
  - d. Human genome project. (1 hrs)
  - e. Gene therapy and Antisense technology (2 hrs).
  - f. Biotechnology related techniques: Protein engineering, Peptide chemistry and peptidomimetics, Nucleic acid technologies, catalytic antibodies, glycobiology. (6 hrs)
  - g. Principles of cell based assays and their application: MTT assay, COMET assay, DNA ladder, Radio-ligand binding assay, RT-PCR, Western blotting, Immunoblotting, Immunofluorescence, Flow cytometry. (6 hrs)

**BOOKS:**

1. Molecular biology of the CELL. Alberts B. et.al (Eds). Garlound Publishing Inc. New York and London.
2. Pharmaceutical Biotechnology. Crommelin DJA and Sindelar RD. (Eds). Harward Academic Publishers, Australia, UK.
3. Biopharmaceuticals: Biochemistry & Biotechnology. Gary Walsh. (Eds). John Wiley and Sons.
4. Recombinant DNA. James D. Watson, Michael Gilman, Jan Witowski, Mark Zollet (Eds). Scientific American Books, New York
5. The Cell: A Molecular Approach. Geoffrey M Cooper and Robert E Hausman (Eds). 5<sup>th</sup> ed
6. S P Vyas and D V Kohli, Pharmaceutical Biotechnology
7. Kumarsan
8. Satynarayan

**PRACTICALS****(6 Hrs/wk)**

1. Drug mutagenicity study using mice bone-marrow chromosomal aberration test.
2. Drug mutagenicity study using mice bone-marrow micronucleus test.
3. Ames test (Salmonella typhimurium)
4. Drug cytotoxicity using a cell line (MTT or any other assay)
5. Polyacrylamide Gel Electrophoresis
6. Western Blotting.
7. Isolation and estimation of DNA and RNA.
8. Restriction digestion of DNA.
9. Ligation of DNA.
10. Isolation of plasmids.
11. Estimation of proteins by Bradford /or Lowrys

**Scheme or examination:**

Synopsis	20 marks
Major experiment	35 marks
Minor experiment	25 marks
Viva-voce	20 marks
Total	100 marks