

**CORE COURSE - VII – MOLECULAR BIOLOGY**

**Unit 1 Prokaryotic transcription and regulation**

Replication of DNA: DNA in prokaryotes and eukaryotes. Enzymes involved in replication, events on the replication fork and termination, mechanism of replication. Inhibitors of DNA replication and DNA repair. Type of damages, types of mutation – point mutation and frame shift mutation. Suppressor mutations – nonsense & missense suppression. Gene mutation and chromosomal aberration. Basic principles of transcription. Transcription-initiation, elongation and termination. . Inhibitors of transcription. Post-transcriptional processing of rRNA and tRNA. Regulation of transcription in prokaryotes– the lac, trp, Arab, Gal operon.

**Unit 2 Eukaryotic transcription and regulation**

Eukaryotic RNA polymerases- structure and functions. RNA pol I, II and III-promoters, transcription factors, transcription complex assembly and mechanism of transcription. Transcriptional regulation in eukaryotes-hormonal (steroid hormone receptors), phosphorylation (Stat proteins), activation of transcriptional elongation by HIV Tat protein, cell determination, homeodomain proteins. Post-transcriptional processing of mRNA, rRNA and t-RNA. Alternative splicing. Catalytic RNA (ribozymes), RNA editing, Antisense RNA and RNAi

**Unit 3 Genetic code, translation**

The genetic code- general features. Mitochondrial genetic code. Components of protein synthesis– mRNA, ribosomes and tRNA. Mechanism of protein synthesis in bacteria and eukaryotes- amino acid activation, initiation, elongation and termination. Translational control in bacteria and eukaryotes. Regulation of protein synthesis- constitutive, and narrow domain regulation. Inhibition of protein synthesis. Co- and post-translational modifications. Protein targeting- the signal sequence hypothesis, targeting proteins to membranes, nucleus and intracellular organelles. Protein degradation: the ubiquitine pathway. Protein folding- models, molecular chaperones.

**Unit 4 Gene expression and regulation**

Levels of gene expression. Principles of gene regulation, Upregulation, downregulation, induction, repression, global and narrow domain mechanisms. Genetic and epigenetic gene regulation by DNA methylation. DNA methylation in prokaryotes-restriction- modification systems, Dam methylation, Dcm methylation. DNA methylation in eukaryotes- cytosine methylation, CpG islands. Methylation and gene regulation in mammals and plants. Epigenetic gene regulation by DNA methylation in mammals- role of imprinting and X-chromosome inactivation.

**Unit 5 Genomics**

Genomics: an overview. Genome projects: HGP Genome sequencing approaches; Structural genomics; chromosome maps– RFLP, SSLP, RAPD Physical mapping. Positional cloning. Functional genomics– study of gene interactions; Proteomics. SNPs and implications; DNAmicro arrays. Developmental genetics: overview. Drosophila development maternal effect genes and zygotic genes.

### **Books recommended**

1. Lewin. Genes VII. Oxford University Press 2000.
2. Twyman. Advanced Molecular Biology Viva Publ. 2nd ed 1998.
3. Alberts. Molecular Biology of the Cell. 4th ed. Garland Sci. 2002.
4. Lodish et al. Molecular Cell Biology. 4th ed. Freeman 2000
5. Pitot HC. Fundamentals of Oncology. Marcel Dekker, 2002.
6. Stansfield et al. Molecular Cell Biology. Schaum's Outlines. McGraw Hill, 1996.