II SEMESTER

BTH 451 MOLECULAR BIOLOGY

Hours: 52

Course outcomes:

After successful completion of the course, students will be able to:

CO 1. Understand the processes involved in the central dogma of molecular biology i.e. replication, transcription and translation in both prokaryotic and eukaryotic systems.
CO 2. Comprehend translational modifications, transport and inhibition.
CO 3. Learn about control and regulation of gene expressions and operon models arediscussed.
CO 4. Elucidate mechanisms and agents of cancer.
CO 5. Acquire knowledge in developmental biology and cell signaling.

Unit I (13 hrs)

Central Dogma of molecular biology and its modifications. DNA Replication: Semiconservative mechanism, prokaryotic and eukaryotic DNA replication, Okazaki fragments; enzymology and control of DNA replication; inhibitors of replication; Replication in Øx 174, M-13, T-phages and Lambda phages. Transcription: Prokaryotic and Eukaryotic Transcription - RNA polymerase sub units, different sigma factors, initiation, elongation and termination - rho dependent and independent; antitermination, control by antisense RNA; attenuation and other influences of translational apparatus on the process of transcription, eukaryotic promoters, enhancers, transcription factors, various protein motifs involved in DNA protein interaction during transcription. RNA processing enzymes, modification in RNA: 5'-Cap formation; Transcription termination; 3'-end processing and polyadenylation; Splicing; RNA Editing, Nuclear export of mRNA; mRNA stability. Different modes of mRNA, tRNA, and rRNA splicing, role of various snRNPs.

Unit II (13 hrs)

Translation in Prokaryotes and Eukaryotes: Genetic code, initiation of translation, chain elongation, Termination, post-translational modification and structure determination and involvement of different translational factors at different stages of the process. Folding of polypeptides; involvement of molecular chaperons. Protein splicing. Inhibitors of translation, translational control mechanism. Organization of prokaryotic and eukaryotic genomes. Regulation of gene expression in prokaryotes and eukaryotes, operon concept, catabolic repression, repressible enzyme systems, control by attenuation, positive control, gene regulation in eukaryotes, transcriptional regulation, post-transcriptional regulation. Environmental regulation of gene expression.

Unit III (13 hrs)

Molecular biology of cancer: Abnormal cell growth: mechanism of transformation of cells. Genetic basis of Cancer, Physical and chemical carcinogenic agents; Viral and cellular

oncogenes, tumor suppressor genes, Telomerases and their role in cancer. Developmental Biology: Gene action during oogenesis, transcriptional role of oocyte lamp brush chromosomes, ribosomal RNA synthesis during oogenesis, spermatogenesis, Molecular and cellular biology of fertilization: acrosome reaction and signal transduction, monospermy and species-specificity. Egg activation, cleavage morphogenetic movements, Genetic basis of differentiation, molecular genetics of pattern formation - in *Drosophila*, *C. elegans*, *Xenopus* and mouse (in brief). Nuclear cytoplasmic interactions during development.

Unit IV (13 hrs)

Cell signaling: Various types of cell signaling-endocrine, paracrine, juxtacrine and autocrine. Signaling molecules – hormones, growth factors, neurotransmitters, gases, lipids, peptides, Cellular responses to environmental signals in plants and animals; Receptors - extra cellular (G-protein coupled receptors, Ion channel receptors, Tyrosine kinase linked receptors & Receptors with intrinsic enzyme activity (RTK) and Intracellular receptors (cytosolic and nuclear receptors). Mechanisms of signal transduction and second messengers - Ca^{2+}, IP_3, DAG, cAMP & cGMP. Signalling pathways during development. Integrating cells into tissues: Cell adhesion, Cell junctions; Extracellular matrix, extracellular matrix receptors and signaling.

References

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2) The Cell - A Molecular Approach. Cooper, G.M. Sunderland: Sinauer Associates, Inc, 2000
3) Cell and Molecular Biology. De Robertis, E.D.P. and De Robertis, E.M.F. B.I. Waverly Pvt. Ltd., 1971
4) Developmental Biology. Gilbert, S.F. Sinauer Associates, Inc., 2000
5) Molecular cell Biology. Lodish, H., Berk, A., Zipursky, S.L. et al. WH. Freeman and Co, 2000
6) Cell & Molecular Biology – Concepts & experiments. Karp, G., Harris, D., Wiley & sons, 1999
7) Principles of Cell and Molecular Biology. Kleinsmith, L.J. & Kish, V.M. McLaughlin, S., Trost,K., Mac Elree, E., Harper Collins Publishers, 1995
8) Genes VII. Lewin, B. Oxford University Press, 2000
9) Molecular biology: genes to proteins. Tropp BE., Jones & Bartlett, 2010
10) Essential of Molecular biology. Freifelder D., Jones & Bartlett, 1985
11) Molecular Biology of Gene. Watson JD., Baker TA., Bell SP., et al., Pearson Edu. Inc. 2013
12) Molecular Biotechnology: Principles and applications of recombinant DNA. Glick BR. andPasternak JJ. ASM Press, Washington, 2009