Title of the Course: MOLECULAR BIOLOGY [T]

Course Code: MIC-512
Number of Credits: 3, Theory
Contact hours: 45
Effective from Academic Year: 2022-23

Prerequisites	It is assumed that the students have a basic knowledge of DNA (structure and replication), transcription and protein synthesis	
Objective:	To enhance the comprehension of concepts in molecular biology.	
Content:		
1.	**Chromosome architecture and eukaryotic DNA replication**	**(15)**
1.1	**Nucleic acids, types of DNAs and DNA packaging**	**4**
A.	Structure of DNA and RNA.	
B.	Types of DNA (A-DNA, B-DNA, Z-DNA and triplex DNA) and their structural characteristics.	
C.	DNA packaging in bacteria (nucleoid) and viruses.	
1.2	**Chromosomes, genomes and their evolution**	**5**
A.	Fundamental functions of DNA.	
B.	Chromosomal DNA and its packaging in the chromatin fibre, chromatin organization.	
C.	Structural features (telomere, centromere and repetitive sequences) of chromosomes and their functions. Lampbrush and polytene chromosomes.	
D.	Evolution of genomes, paralogous and orthologous evolution of duplicated genes	
1.3	**DNA replication in eukaryotes**	**6**
	DNA replication in the context of the cell cycle; Structure and functions of eukaryotic DNA polymerases, functions of other enzymes (helicase, gyrase, topoisomerase, primase, ligase, telomerase); Steps involved in DNA replication; Similarities and differences between prokaryotic and eukaryotic DNA replication.	
2.	**DNA damage, repair and recombination**	**(15)**
2.1	**DNA damage and repair mechanisms**	**8**
A.	Types of DNA damage: spontaneous and induced DNA damage.	
B.	Mechanisms / pathways to remove damaged DNA: Excision repair, mismatch repair, recombination repair, SOS Repair, photoreactivation repair.	
2.2	**Mechanisms of genetic recombination**	**7**
A.	General and site-specific recombination.	
B.	Homologous recombination, Non-homologous end joining (NHEJ).	
C.	Synaptonemal complex, Bacterial RecBCD system and its stimulation of chi sequences.	
D.	Role of RecA / RAD51 in repair and recombination	

3.	**Gene expression and its regulation in prokaryotes and eukaryotes**	**(15)**
A.	The central dogma concept, DNA to RNA to protein	**1**
B.	The RNA world and the origin of life.	**2**
C.	An overview of gene expression control, DNA binding motifs in gene regulatory proteins, genetic switches and their role in the control of gene expression, combinatorial gene control.	**2**
D.	Structure and function of prokaryotic and eukaryotic RNA: Prokaryotic and eukaryotic mRNA, tRNA, rRNA and ribosomes, processing of eukaryotic hnRNA, snRNA.	**2**
E.	Post-transcriptional controls: Transcriptional attenuation, riboswitches, alternate splicing, RNA editing, RNA interference.	**3**
F.	Synthesis and processing of proteins: The genetic code, aminoacylation of tRNA, mechanism of protein synthesis, translational proof-reading, translational inhibitors.	**3**
G.	Protein folding, post-translational modifications of proteins, leader sequences, protein localization and secretion.	**2**
Pedagogy:	Lectures/tutorials/assignments	
References/ Readings	Alberts, B., Heald, R., Johnson, A., Morgan, D., Raff, M., Roberts, K., Peter Walter, P., Molecular Biology of the Cell. WW Norton & Co. (2022).	
	Darnell, J. E., Lodish, H. F. and Baltimore, D., Molecular Cell Biology, Scientific American Books, Spektrum Akademischer Verlag. (1990)	
	Davis, L. G., Dibner, M. D. and Battey, J. F., Basic Methods in Molecular Biology, Elsevier (1986).	
	Gardner, E. J., Simmons, M. J. and Snustad, D. P. Principles of Genetics, John Wiley & Sons (2006).	
	Gerhardt, P., Methods for General and Molecular Bacteriology, Elsevier (1994).	
	Green, M. R. and Sambrook, J., Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory, New York (2014).	
	Krebs, J.E., Krebs J.E., Lewin B., Goldstein E.S. and Kilpatrick, S.T., LEWIS Genes XII, Jones and Bartlett Publishers (2018)	
	Malacinski, G.M., Freifelder's Essentials of Molecular Biology, Narosa Book Distributors Private Limited (2008).	
	Tamarin, R. H., Principles of Genetics, McGraw-Hill Higher Education (2017).	
	Twyman, R. M. and Wisden, W., Advanced Molecular Biology: A Concise Reference, Garland Science (1998).	
	Watson, J. D., Molecular Biology of the Gene, Pearson/Benjamin Cummings (2007).	
Course Outcomes	◆ Classify genome and gene structure. ◆ Summarize the regulation of gene expression in both prokaryotes and eukaryotes. ◆ Explain DNA damage and repair. ◆ Connect genomics to expressed proteins.	