Name of the Programme: M.Sc. Part-I (Biochemistry)

Course Code: CHB-502 **Title of the Course:** Molecular Biology

Number of Credits: 4

Effective from AY: 2022-23

Pre-requisites for the Course:	Students should have graduate level knowledge either in chemical or life sciences or should have qualified change of discipline test.	
Course Objectives:	1. To introduce the students to the structure of nucleic acids, their folding and packaging inside living cells and viruses. 2.To acquaint the students with concepts of damage to DNA, the repair mechanisms initiated by the cell and the expression and regulation of genes in prokaryotes and eukaryotes.	
Content:		**No of hours**
	1. Mendelian Genetics a. Basic concepts of Mendelian genetics: Mendel's Principles, Mendel's experiment, allele, wild-type and mutant alleles, dominant and recessive allele, homozygous and heterozygous, genotype, phenotype. b. Laws of inheritance: Mendel's law of inheritance, Law of segregation, monohybrid cross, test cross, Law of independent assortment, incomplete dominance and codominance, multiple alleles. c. Prediction, expression and probability: predicting blood groups of progeny, lethal alleles, penetrance and expressivity, Probability: predicting outcome of genetic crosses.	10
	2. Structure and properties Nucleic acids a. DNA as genetic material: Structure of DNA and RNA, Types of DNA based on their structure and their importance in cell (A-DNA, B-DNA, Z-DNA), Types of DNA based on the functionality and their importance in cell (Satellite DNA, Palindrome DNA, Repetitive DNA). b. RNA: Types of RNA (mRNA, antisense mRNA, rRNA, tRNA), their structure and functions. c. Functions and properties of DNA: Fundamental functions of DNA, Buoyant density, melting temperature (Tm), DNA reassociation kinetics (Cot curve analysis), DNA methylation and epigenetic effects (Agouti gene methylation, maternal diet and offspring coat colour).	12
	3. Genome organization and Packaging a. Viruses (icosahedral capsid and helical capsids) b. Prokaryotes (supercoiling, nucleosomes and nonhistone proteins) c. Eukaryotes (supercoiling, nucleosomes, histones, chromatin and chromosome). d. Heterochromatin and euchromatin, Importance of structural features of chromosome (telomere,	6

	centromere and repetitive sequences), Functions of the chromosomes.	
	4. Model organisms and Mechanisms of gene transfer a. *Escherichia coli as* a model prokaryotic organism. b. Yeast as a model eukaryotic organism. c. Mechanisms of Gene Transfer: transformation, transduction, conjugation, plasmids (natural, artificial), episomes.	5
	5. Mechanisms of DNA damage, repair and recombination a. Mutations and mutagenic agents: Types of mutations (point mutations, frameshift mutations, forward mutations, reverse mutations, suppressor mutations, transitions and transversions), Role of Mutagenic agents (spontaneous and induced mutagenic agents). b. DNA repair mechanisms/ pathways: (Base excision repair, Mismatch repair, SOS repair, Photoreactivation repair, recombination repair. c. Mechanisms of Genetic recombination: Homologous and site-specific recombination, Role of synaptonemal complex, lamp brush chromosomes, chi sequences, Rec BCD system, Role of Rec A, Ruv C, Holliday junctions.	12
	6. Flow of genetic information and expression of genes in prokaryotes and eukaryotes, **Concept of Central Dogma** a. Replication: replication of DNA, semi conservative nature of DNA replication. b. Transcription: transcription factors and machinery, formation of transcription initiation complex, transcription activators and repressors, RNA polymerases, capping, elongation, and termination, RNA to proteins (reverse transcription). Post transcriptional modifications: attenuation, riboswitches, alternate splicing, RNA interference, RNA processing, RNA editing, and polyadenylation, RNA transport. c. Translation: structure of Ribosome (eukaryotes and prokaryotes), formation of translation initiation complex, initiation factors and their role in regulation of initiation of translation, elongation and elongation factors, termination, genetic code, aminoacylation of tRNA, tRNA-identity, aminoacyl tRNA synthetase, and translational proof-reading, translational inhibitors, Post translational modification of proteins in prokaryotes and Eukaryotes.	11
	7. **Control of gene expression at transcription and translation level** a. Regulation of gene the expression of phages, viruses, prokaryotic and eukaryotic genes.	4

	b. Role of chromatin in gene expression and gene silencing. c. Role of Recognition sequences or motifs of gene regulatory proteins, Genetic switches and their role in gene expression.	
Pedagogy:	Mainly lectures and tutorials. Seminars / term papers /assignments / presentations / self-study or a combination of some of these can also be used. ICT mode should be preferred. Sessions should be interactive in nature to enable peer group learning.	
References/ Readings:	1. J.D. Watson, Molecular Biology of the Gene. Pearson/Benjamin Cummings, 2013. 2. B. Alberts, A. Johnson, Molecular biology of cell. Garland Science, 2014. 3. N. Craig, O. Cohen-fix, R. Green, Molecular Biology: Principles of Genome function. Oxford University Press, 2014. 4. H. Lodish, A. Berk, P. Matsudaira, C.A.Kaiser, M.Krieger, M.P. Scott, L. Zipursky, & J. Darnell, Molecular cell biology. W.H. Freeman, 2008.	
Course Outcomes:	1. The student will be able to outline and explain the fundamental concepts of genetics like structure and packaging of nucleic material. 2. The student will be able to illustrate and explain the mechanisms of DNA damage, repair and recombination. 3. The student will be able to describe and discuss the process of expression of genes in prokaryotes and eukaryotes. 4. The student will gain the knowledge of basic molecular processes that occur within the cell.	