BACHELOR WITH BIOTECHNOLOGY AS MAJOR

4th SEMESTER

BTG 422J2: Molecular Biology

CREDITS: THEORY – 4, PRACTICAL – 2

MAXIMUM MARKS: 100, MINIMUM MAILKS: 36

- Course Learning Objective: aim of this course is to understand information flow at molecular level, appreciate the functions of DNA, RNA and protein and how these regulate different biological processes.
- **Course outcome:** A student will be able to;
  - Analyze the different properties of nucleic acids and genomes.
  - Interpret and predict the role of different enzymes and proteins involved in replication of DNA, mutation and repair.
  - Illustrate the process of gene expression, factors involved, processing and regulation of expression.
  - Describe how the language of the nucleic acids is translated into proteins and its regulation.

UNIT – I 15 hours

DNA as genetic material (Griffith, Avery-MacLeod-McCarty and Hershey and Chase experiments), RNA as genetic material (Fraenkel Conrat experiment). DNA structure - features of double helix, forms of DNA (A, B, Z, H). Forces stabilizing DNA. DNA topology, Genome and C-value paradox, Genome complexity (Cot curve, repetitive, non-repetitive sequences). Organization of prokaryotic and eukaryotic genomes.

UNIT – II 15 hours

DNA Relication in prokaryotes, modes of replication (semi-conservative, conservative, dispersive, continuous, discontinuous and bi-directional replication), origin of replication (prokaryotic and eukaryotic), Enzymes and proteins involved: DNA polymerases, helicases, topoisomerase and ligase, proof reading, leading and lagging strand synthesis. Rolling circle replication (λ and M13). End replication of linear DNA (telomerase). DNA Mutations: Base substitution, missense, non sense, deletion, insertion, frame shift, silent). DNA damage: radiation, alkylation and oxidative. DNA repair: photo-reactivation, base excision, nucleotide excision, mismatch and recombination repair.

UNIT – III 15 hours

Transcription in prokaryotes: RNA polymerase, role of σ factor, promoter, initiation, elongation and termination. Operon concept, positive and negative regulation with reference

to *lac* and *trp* operons. Eukaryotic transcription: RNA polymerases, promoters, promoter clearance, enhancers, silencers, transcription factors/domains (zinc finger domains, leucine zippers, basic domains). Post-transcriptional processing - 5' cap formation, splicing, polyadenylation. Brief outline of rRNA and tRNA processing. Inhibitors of transcription.

UNIT – IV 15 hours

Protein translation machinery: ribosomes, mRNA, tRNA, charging of tRNA, aminoacyl tRNA synthetases, translation initiation (prokaryotes and eukaryotes).Genetic code – its salient features, Wobble hypothesis, reading frames, mechanism of elongation and termination in prokaryotes and eukaryotes. Inhibitors of translation. Post-translational modifications of proteins. Translation regulation.

PRACTICALS (2 CREDITS: 30 hours) Maximum Marks: 50, Minimum Marks: 18

1. Isolation of genomic DNA from bacterial cells.
2. Qualitative analysis of DNA by agarose gel electrophoresis.
3. Isolation of RNA from cells.
4. Quantitative estimation of RNA and DNA by spectrophotometry.
5. DNA denaturation and renaturation curves and calculation of Tm.
6. Lab visits/ Field trip/ subject tour etc.

Suggested Reading:

1. Cell and Molecular Biology: Concepts and Experiments, Karp, G. John Wiley & Sons. Inc.
2. The Cell: A Molecular Approach. Cooper, G.M. and Hausman, R.E ASM Press
3. The World of the Cell, Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. Benjamin-Cummings Pub
4. Molecular Biology of the Gene, J Watson, T Baker, S Bell, A Gann, M Levine, R Losick, Pearson
5. Lewins Genes XI J E. Krebs, S T. Kilpatrick, E S. Goldstein Jones & Bartlett Learning
6. Molecular Cell Biology Harvey Lodish, Arnold Berk, Chris A. Kaiser Monty Krieger, Anthony Bretscher, W H Freeman & Co
7. Molecular Biology, David Freifelder, Narosa Publishers.