SEMESTER-V
B.Sc. (Hons.) Microbiology

DISCIPLINE SPECIFIC CORE COURSE – 13: PRINCIPLES OF MOLECULAR BIOLOGY-I

CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical/ Practice		
MICROB-DSC501: **PRINCIPLES OF MOLECULAR BIOLOGY-I**	**4**	**3**	**0**	**1**	**Class XII pass with Biology/ Biotechnology/ Biochemistry**	**NIL**

Learning Objectives

The Learning Objectives of this course are as follows:

- The major objective of this course is for the student to gain comprehensive knowledge of the basic concepts of molecular biology.
- The student will become familiar with DNA-related cellular processes and will become aware of the central dogma of molecular biology, learning about the propagation of information through DNA replication and the unidirectional flow of information from DNA to RNA to proteins through transcription and translation

Learning outcomes

The Learning Outcomes of this course are as follows:

- Student will be able to describe DNA and RNA as genetic material and the structure and properties of the different DNA types as well as the various kinds of RNA.
- Student will be able to explain the process of propagation of information in prokaryotes and eukaryotes by DNA replication and the various enzymes and other proteins that modulate this process.
- Student will be able to describe the basic prokaryotic and eukaryotic transcription processes, including the RNA polymerases and general transcription factors involved, differentiate between the processes in prokaryotes and eukaryotes.
- Student will be able to evaluate the relevance of the double helical structure of DNA in the propagation of genetic material.
- Student will be able to demonstrate the isolation of genomic DNA and plasmid from bacterial cells, and analyze them through agarose gel electrophoresis.

SYLLABUS OF DSC-13

UNIT – I (12 hours)

Structure and properties of nucleic acids: Types of genetic material: DNA and RNA. Structure of DNA: characteristic features of double helix. Properties of different types of DNA: A, B and Z. Denaturation and renaturation of DNA, factors affecting renaturation kinetics, concept of Tm. Principle and method of cot curve analysis of DNA. Factors affecting DNA topology: role of topoisomerases I and II. Concept of linking number. Concept of concatenation and concatamerization. DNA organization in prokaryotes and eukaryotes. Structure and function of RNA: rRNA, tRNA and mRNA.

UNIT – II (17 hours)

Replication of DNA in prokaryotes and eukaryotes: Semi-conservative DNA replication. Unidirectional and bidirectional DNA replication. DNA replication modes with one example each: D-loop (mitochondrial), Θ (theta), rolling circle. Structure of origins of replication in prokaryotes versus eukaryotes, initiators and replicators. Mechanism of origin activation in prokaryotes (E.coli) and eukaryotes (S.cerevisiae). Mechanism of DNA replication: semi-discontinuous replication, leading and lagging strand synthesis. Replication machinery in prokaryotes and eukaryotes: primase, DNA polymerases, DNA ligase. Mechanisms for maintaining fidelity of replication. Differences in prokaryotic and eukaryotic DNA replication. Regulation of replication in prokaryotes and eukaryotes. Replication of chromosome ends: mechanism of action of telomerase, importance of telomerase in ageing.

UNIT – III (16 hours)

Transcription in prokaryotes and eukaryotes: Distinction between replication and transcription. Concept of transcription unit. Concept of operon and polycistronic transcription in prokaryotes. RNA polymerases in prokaryotes and eukaryotes. Structure and properties of promoter in prokaryotes and eukaryotes. Role of enhancers and silencers in gene regulation. General transcription factors in eukaryotes. Process of transcription initiation and elongation in prokaryotes and eukaryotes. Transcription termination: rho-dependent and rho-independent termination mechanisms. Inhibitors of transcription and their mechanism. Comparison of the transcription process in prokaryotes versus in eukaryotes

Practical component

UNIT 1: (12 hours)

Study of different types of DNA and RNA:

Student research study project: Discovery of DNA as genetic material. Discovery of structure of DNA: the double helix.

Study of the structure and properties of different types of DNA using micrographs and/or models: A-DNA, B-DNA and Z-DNA. Study of the structure and properties of various RNAs using micrographs: mRNA, rRNA, tRNA, miRNA, siRNA, guide RNA, xistRNA, snRNA, snoRNA. Discussion on the importance of the double helix

structure in DNA replication by semi- conservative mode: the Meselson & Stahl experiment.

Unit 2: (18 hours)

Isolation and analysis of DNA:

Isolation of genomic DNA from Escherichia coli cultures: cell lysis and DNA precipitation. Analysis of the isolated genomic DNA: principle and working method of agarose gel electrophoresis. Isolation of plasmid DNA using alkaline lysis method. Analysis of the isolated plasmid DNA by agarose gel electrophoresis. Identification of the different forms of plasmid DNA by agarose gel electrophoresis.

DNA estimation: colorimetric estimation of DNA using salmon sperm DNA or calf thymus DNA as standard: diphenylamine method. Spectrophotometric method using absorbance at 260 nm.

Essential/recommended readings

Theory:

1. Lewin's Essential Genes by J. Krebs, E. Goldstein and S. Kilpatrick. 4th edition. Jones andBartlett Publishers, USA. 2020.
2. Karp's Cell and Molecular Biology by G. Karp, J. Iwasa and W. Marshall. 9th edition. Wiley, USA. 2019
3. Molecular Biology by D. Clark, N. Pazdernik and M. McGehee. 3rd edition. Academic Cell, USA. 2018.
4. Lewin's Genes XII by J. Krebs, E. Goldstein and S. Kilpatrick. 12th edition. Jones and BartlettLearning, USA. 2017.
5. Becker's World of the Cell by J .Hardin and G.P. Bertoni. 9th edition. Pearson, USA. 2015.
6. Principles of Genetics by D.P. Snustad and M.J. Simmons. 7th edition. Wiley and Sons, UK. 2015.
7. Molecular Biology of the Gene by J.D. Watson, T.A. Baker, S.P. Bell, A. Gann, M. Levine and R. Losick. 7th edition. Pearson Education, USA. 2014.
8. Cell and Molecular Biology by E.D.P. De Robertis and E.M.F. De Robertis. 8th edition. Lippincott Williams and Wilkins, USA. 2006.

Practicals:

1. Molecular Cloning: A Laboratory Manual by M. Green and J. Sambrook Volumes 1-3. 4th edition. Cold Spring Harbor Laboratory Press, USA. 2012.
2. An Introduction to Practical Biochemistry by D. Plummer. 3rd edition. McGraw Hill Education, India. 2017.

Suggestive readings

Note: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.