

<b>Semester: 4</b>	
<b>Course: Major 1</b>	
<b>Paper Title: Prokaryotic Molecular Biology</b>	
<b>Paper Code: C2BT230411T</b>	<b>Credits: 4</b>
<b>Hours/week: 4</b>	
<b>Category: Core/MDC/SEC/VAC: Core</b>	
<b>Theory / Practical / Composite: Theory</b>	
<b>No of Modules : 2</b>	
<b>Course Overview:</b>	
<p>This course provides an in-depth understanding of the molecular mechanisms governing genetic information flow in prokaryotic systems, encompassing DNA topology, replication, recombination, transcription, and translation. The course emphasizes mechanistic details, regulation, fidelity, and coordination of molecular processes, highlighting how accuracy and regulation ensure genome stability and proper gene expression. Through this course, learners develop the ability to integrate structural, biochemical, and regulatory principles, critically analyse experimental and biological scenarios, and construct coherent mechanistic models relevant to molecular biology and biotechnology.</p>	
<b>Course Outcome:</b>	
<b>Module A</b>	
1. <b>Remember</b> the fundamental concepts, terminology, and components involved in DNA supercoiling, prokaryotic DNA replication, and homologous recombination.	
2. <b>Understand</b> the molecular principles governing DNA topology, replication fork dynamics including processivity, and recombination mechanisms.	
3. <b>Apply</b> knowledge of replication and recombination machinery to explain genome duplication, repair of damaged replication forks, and maintenance of genetic integrity.	
4. <b>Analyse</b> the roles of topoisomerases, different components of replisome, and recombination intermediates in regulating DNA structure, fidelity, and continuity.	
5. <b>Evaluate</b> the biological significance of replication fidelity, regulatory mechanism of initiation phase, and recombination-mediated repair, in prokaryotic survival and evolution.	
6. <b>Create</b> a connectivity map amongst supercoiling, replication process and homologous recombination that guarantees speed and fidelity of prokaryotic replication and hence genetic integrity.	
<b>Module B</b>	
1. <b>Remember</b> the components, steps, and key factors involved in prokaryotic transcription and translation.	
2. <b>Understand</b> the regulation of gene expression at transcriptional and translational levels, including operon systems.	
3. <b>Apply</b> molecular principles to explain promoter recognition, RNA synthesis, ribosome function, decoding of genetic information, and protein synthesis.	
4. <b>Analyse</b> regulatory mechanisms controlling transcription initiation, elongation, termination, translational fidelity, and the action of inhibitors.	
5. <b>Evaluate</b> the efficiency, accuracy, and biological relevance of gene expression regulation in response to cellular and environmental signals.	

6. **Integrate** knowledge of transcriptional and translational mechanisms to explain how gene expression is coordinated and regulated in prokaryotic cells.

**Prerequisites:** Basic knowledge about biology

**SYLLABUS**

UNIT/Module	CONTENT	HOURS or NUMBER OF CLASSES	CO Mapping	COGNITIVE LEVEL
<b>Module A</b>	<p>UNIT I: Supercoiling: DNA supercoiling – linking number, negative and positive supercoiling, topoisomerases.</p> <p>UNIT II: Prokaryotic Replication: Characteristics - semiconservative, discontinuous, single origin, bidirectional replication forks; DNA polymerases; Replication complexes - prepriming proteins, primosome and replisome; Initiation, elongation and termination of replication; Fidelity of replication; Rolling circle and looped rolling circle modes of replication,</p> <p>UNIT III: Homologous Recombination: Mechanism – Holliday intermediate; Repair of damaged replication forks – single or double stranded breaks.</p>	2 class per week	CO1-CO6	K1-K6
<b>Module B</b>	<p>UNIT IV: Prokaryotic transcription: RNA polymerase, role of sigma factor, promoter, initiation, elongation and termination of RNA chains; Regulation of gene expression in prokaryotes - Operon concept (inducible and repressible system). Intricate transcriptional regulation of</p>	2 classes per week	CO1-CO6	K1-K6

	bacteriophage $\lambda$ infection of E. coli.  Unit V: Prokaryotic Translation: Discovery of genetic code and its characteristics; Ribosome structure and assembly; Charging of tRNA (aminoacyl tRNA synthetases); Mechanism of initiation, elongation and termination of polypeptides; Fidelity of translation; Inhibitors of translation.			
<b>Text Books</b>				
	1. Biochemistry - Lubert Stryer			
	2. Lehninger Principles of Biochemistry - David L. Nelson and Michael Cox			
	3. Molecular Biology – Weaver			
	4. Molecular biology of the gene - Watson			
<b>Suggested readings</b>				
	1. Biochemistry – Voet & Voet			
<b>Evaluation:</b>				
	<b>CIA- 20</b>			
	<b>Assignment – 05</b>			
	<b>Attendance - 05</b>			
	<b>Semester Exam- 70</b>			
<b>Paper Structure for Theory Semester Exam:</b>				
<b>Module A: (35 marks)</b>				
	• 1 Compulsory Question – objective-type: $1 \times 10 = 10$ marks			
	• Any 2 out of 3 questions; each of 12½ marks, with subparts (no subpart will be less than 1 mark): $2 \times 12.5$ marks = 25 marks			
<b>Module B: (35 marks)</b>				
	• 1 Compulsory Question – objective-type: $1 \times 10 = 10$ marks			
	• Any 1 out of 2 questions; each of 10 marks, with subparts (no sub-part will be more than 5 marks, and less than 1 mark): $1 \times 10$ marks = 10 marks			
	• Any 3 out of 5 questions; each of 5 marks, with subparts (no sub-part will be more than 4 marks, and less than 1 mark): $3 \times 5$ marks = 15 marks			

### Course outcomes (COs) and Cognitive Level Mapping

COs	CO Description	Cognitive levels
	<b>Module 1</b>	
<b>CO1</b>	<b>Remember</b> the fundamental concepts, terminology, and components involved in DNA supercoiling, prokaryotic DNA replication, and homologous recombination.	K1

<b>CO2</b>	<b>Understand</b> the molecular principles governing DNA topology, replication fork dynamics including processivity, and recombination mechanisms.	K2
<b>CO3</b>	<b>Apply</b> knowledge of replication and recombination machinery to explain genome duplication, repair of damaged replication forks, and maintenance of genetic integrity.	K3
<b>CO4</b>	<b>Analyse</b> the roles of topoisomerases, different components of replisome, and recombination intermediates in regulating DNA structure, fidelity, and continuity.	K4
<b>CO5</b>	<b>Evaluate</b> the biological significance of replication fidelity, regulatory mechanism of initiation phase, and recombination-mediated repair in prokaryotic survival and evolution.	K5
<b>CO6</b>	<b>Create</b> a connectivity map amongst supercoiling, replication process and homologous recombination that guarantees speed and fidelity of prokaryotic replication and hence genetic integrity.	K6
	<b>Module 2</b>	
<b>CO1</b>	<b>Remember</b> the components, steps, and key factors involved in prokaryotic transcription and translation.	K1
<b>CO2</b>	<b>Understand</b> the regulation of gene expression at transcriptional and translational levels, including operon systems.	K2
<b>CO3</b>	<b>Apply</b> molecular principles to explain promoter recognition, RNA synthesis, ribosome function, decoding of genetic information, and protein synthesis.	K3
<b>CO4</b>	<b>Analyse</b> regulatory mechanisms controlling transcription initiation, elongation, termination, translational fidelity, and the action of inhibitors.	K4
<b>CO5</b>	<b>Evaluate</b> the efficiency, accuracy, and biological relevance of gene expression regulation in response to cellular and environmental signals.	K5
<b>CO6</b>	<b>Integrate</b> knowledge of transcriptional and translational mechanisms to explain how gene expression is coordinated and regulated in prokaryotic cells.	K6