Gyanmanjari Innovative University

Course Syllabus
Gyanmanjari Science College
Semester-5 (B.Sc.)

Subject: Molecular Genetics of Prokaryotes-BSCMB15314

Type of course: Major

Prerequisite: Basic knowledge of general microbiology, molecular biology, and genetics, ideally with some exposure to basic biochemistry and cell biology.

Rationale: Understanding prokaryotic molecular genetics is crucial for microbiology, providing insights into bacterial function, evolution, antibiotic resistance, and enabling advancements in biotechnology and medicine.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks					Total Marks
				SEE		CCE			
CI	T	P	C	Theory	Practical	MSE	LWA/V	ALA	
3	0	2	4	75	25	30	20	50	200

Legends: CI-Class Room Instructions; T – Tutorial; P - Practical; C – Credit; ESE - End Semester Examination; MSE- Mid Semester Examination; V – Viva; CA - Continuous Assessment; ALA- Active Learning Activities.

3 Credits * 25 Marks = 75 Marks (each credit carries 25 Marks) Theory
1 Credits * 25 Marks = 25 Marks (each credit carries 25 Marks) Practical
SEE 100 Marks will be converted in to 50 Marks
CCE 100 Marks will be converted in to 50 Marks
It is compulsory to pass in each individual component.

GYANMANJARI INNOVATIVE UNIVERSITY BHAVNAGAR

Course Content:

Unit No	Course content	Hrs	% Weightage
1	**Chapter-1 Prokaryotic Genome Organization and DNA Replication** • Structure and organization of bacterial genomes (chromosome, plasmids). • Experimental proof for DNA as genetic material: Work of Griffith; Avery, McCarty and MacLeod; Hershey and Chase. • Typical gene structure, functions of gene. • DNA replication in prokaryotes: Enzymes involved, replication initiation, elongation, and termination. • Messelson and Stahl Experiment.	15	25%
2	**Chapter-2 DNA Repair and Mutation** • DNA damage: Types of DNA damage (e.g. UV damage, chemical damage). • DNA damage: Types of DNA damage (e.g. UV damage, chemical damage). • DNA repair mechanisms: Base excision repair, nucleotide excision repair, mismatch repair, SOS response, and other repair pathways. • Mutagenesis and its applications. • Concept, properties and applications of plasmids their types.	10	25%
3	**Chapter-3 Gene Expression in Prokaryotes** • Transcription: RNA polymerase, promoters, transcription initiation, elongation, and termination. • Translation: Ribosomes, tRNA, mRNA, translation initiation, elongation, and termination. • Regulation of gene expression: Operons (lac operon, trp operon), positive and negative control, attenuation, and other regulatory mechanisms.	10	25%
4	**Chapter-4 Horizontal Gene Transfer and Recombination** • Transformation: Mechanism of DNA uptake by competent cells. • Conjugation: Mechanism of plasmid transfer between bacterial cells. • Transduction: Generalized and specialized transduction. • Transposons and their role.	10	25%

Continuous Assessment:

Sr. No	Active Learning Activities	Marks
1	**Mutation and its roles** Faculty will provide one type of mutation and Students (in group of five) need to analyze the type of mutation and describe it advantages and disadvantages and upload report on to the GMIU web Portal.	10
2	**Replication Relay Race** Students have to prepare chart on Correct order of enzyme roles in replication, understanding of individual enzyme functions and upload the photo of chart on to GMIU web portal.	10
3	**Minor Project preparation** Faculty will assign Topics for Minor project and Student (in group of five) will prepare report. Report needs to upload on GMIU web portal.	10
4	**DNA model** Student (in group of five) will prepare any one type of DNA model and upload photographs on to GMIU web Portal.	10
5	**Attendance**	10
Total		**50**

Suggested Specification table with Marks (Theory): 75

Distribution of Theory Marks **(Revised Bloom's Taxonomy)**						
Level	Remembrance (R)	Understanding (U)	Application (A)	Analyze (N)	Evaluate (E)	Create (C)
Weightage	30%	40%	20%	10%	-	-

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Course Outcome:

After learning the course, the students should be able to:	
CO1	Comprehend the composition and arrangement of prokaryotic genetic material
CO2	Illustrate the processes of transcription and translation in prokaryotes.
CO3	Get insight of the regulation of gene expression in prokaryotes.
CO4	Apply molecular genetic techniques to study prokaryotic systems.

List of Practical:

Sr. No	Descriptions	Unit No	Hrs
1	Isolation of lac⁻ mutants of *Escherichia coli* using UV radiations as mutagen (requires two days to get completed).	4	4
2	Isolation of pigment less mutant of *Serratia marcescens* using UV radiations as mutagen (requires two days to get completed).	4	4
3	Isolation of streptomycin resistant mutants of *Escherichia coli* by gradient plate method (requires three days to get completed).	4	4
4	Isolation of streptomycin resistant mutants of *Escherichia coli* by replica plate method (requires three days to get completed).	4	4
5	Estimation of DNA by DPA method.	4	2
6	Estimation of RNA by orcinol method.	2	2
7	To understand mechanism of biological mutagen – Phage Mu.	2	4
8	Isolation of genomic DNA from *E. coli*.	3	2
9	Ames test and its significance.	1	2
10	Demonstrate a β-galactosidase assay to show the activity of the *lac* operon under different conditions (presence/absence of lactose, IPTG). This provides a clear visual demonstration of gene regulation.	3	4
Total			**32**

Instructional Method:

The course delivery method will depend upon the requirement of content and need of students. The teacher in addition to conventional teaching method by black board, may also use any of tools such as demonstration, role play, Quiz, brainstorming, MOOCs etc.

From the content 10% topics are suggested for flipped mode instruction.

Students will use supplementary resources such as online videos, NPTEL/SWAYAM videos, e-courses, Virtual Laboratory

The internal evaluation will be done on the basis of Active Learning Assignment

Practical/Viva examination will be conducted at the end of semester for evaluation of performance of students in laboratory.

Reference Books:

[1] PRINZIPIEN DER BIOCHEMIETextbook by Albert L. Lehninger, David L. Nelson, and Michael M. Cox
[2] Prescott L, Harley J P, and Klein D A, (2008). Microbiology, 7th edn. Wm C. Brown - McGraw Hill, Dubuque, IA.
[3] Lehninger A.L -2012, Principles of Biochemistry,Freeman, W.H.& ComConn E.E and Stumps P.K(1972), Outlines of biochemistry, 3rd edition,John Wiley & Sons
[4] Practical Microbiology: Patel RJ, Aditya Publications.
[5] Practical Microbiology: Dubey RC and Maheshwari DK, S Chand Publication.