DEPARTMENT OF MICROBIOLOGY				*CLASS: I M.Sc. Microbiology*				
Sem	**Course Type**	**Course Code**	**Course Title**	**Credits**	**Contact Hours/week**	**CIA**	**Ext**	**Total**
II	Major Core - 5	21P2RMC5	Microbial Genetics	4	5	25	75	100

Nature of Course				
Knowledge and skill	✓		Employability oriented	✓
Skill oriented	✓		Entrepreneurship oriented	✓

Course Objectives

1. To understand history of microbial genetics and mutation
2. To understand the basic concepts of bacterial genetics
3. To know the importance of phage genetics
4. To gain knowledge about transposable elements and their roles
5. To know about mechanisms of gene expression in bacteria

Course Learning Outcomes

On successful completion of the programme, the students will be able to

1. Outline the history of microbial genetics and mutation
2. Delineate the basic concepts of bacterial genetics
3. Predict the significance of phage in genetics
4. Interpret the roles of transposable elements in microorganisms
5. Elaborate the mechanisms of gene expression in microbes

Unit	Description	Hours	K- level	CLO
I	**Unit I – History and Mutation** History of microbial genetics. Mendel's laws of heredity. Mutations and genetic analysis - useful phenotypes in bacteria and phage. Luria and Delbruck experiment. Newcombe - Isolation of Auxotrophic mutants - positive and negative selection of mutants. Complementation - allelism and cis/trans tests. Population genetics.	15 hrs	Up to K2	1
II	**Unit II – Bacterial Genetics** Bacterial conjugation - F+, F- Hfr strains. Genetic mapping with Hfr crosses. F- prime factors. Complementation test using F-prime factors. Conjugation in *Streptomyces* and role of Pheromones in plasmid transfer in *Enterococcus faecalis.* Transformation – definition, competence induction, mechanism of DNA uptake in *E.coli*. *Bacillus sp*, and *Haemophilus sp*. Recombination and its mechanisms.	15 hrs	Up to K3	2

III	**Unit III Phage Genetics** Phage biology - virulent and temperate bacteriophages (T7, M13 and P1), gene expression of lambda phage during lytic and lysogenic cycles, phage crosses, recombination and complementation tests with phages. T4 RII locus mapping. Generalized transduction and specialized transduction. Co-transduction. Mapping of bacterial markers.	15 hrs	Up to K3	3
IV	**Unit IV Transposable Elements** Contributions of Barbara McClintock. Transposable genetic elements – IS elements, transposons and their types (Tn3, Tn5, Tn9, Tn10 and μ phage). Identification of transposons. Mechanism of transposition. Transposable elements in eukaryotes –maize, AC and DS elements, spm, dspm, p and copia elements in *Drosophila* and retro transposons.	15 hrs	Up to K4	4
V	**Unit V Gene Expression** Regulation of gene expression- negative regulation (*lac* and *gal* operon). Positive regulation (*trp* and *ara* operon). Role of RNA molecules in gene regulations. Regulatory mechanisms in *E.coli*- catabolite regulation, tRNA and rRNA regulation (stringent control).	15 hrs	Up to K4	5

Total 75 Hours

Books for study:

1. Lodish, H., Daerk, B.A., Zipsury, S.L., Marsudaisa, P. and Darnel, J. (1995). Molecular cell biology. W.H.Freeman & Colorado Ltd., US.
2. Gardner, E.J., Simmons, M.J. and Snustad, P.D. (2008). Principles of genetics. 8th Edition. John Wiley & sons. Inc., New York.

Books for Reference:

1. Maloy, S.R., Cronan, Jr. J.E. and Freifelder. D. (1994). Microbial Genetics. Jones and Barlett publishers, Massachusetts.
2. Jocelyn, E., Krebs, J.E., Goldstein, E.S. and Kilpatrick, S.T. (2017). Lewin's GENES XII. Jones and Bartlett Publishers, Massachusetts.

Web Resources:

1. https://www.ncbi.nlm.nih.gov/genome/microbes/
2. https://www.mdpi.com/journal/genes/sections/MGG
3. https://bmcmicrobiol.biomedcentral.com/articles/sections/microbial-genetics-genomics-and-proteomics
4. https://www.nature.com/subjects/microbial-genetics

Rationale for nature of the course

This course introduces the basic concepts of bacterial genetics to understand genetic make up, gene transfer and mutation. It explores the importance of phage genetics and to gain knowledge about

transposable elements and their roles. The mechanisms of gene expression in bacteria can also be used for constructing genetic map.

Activities having direct bearing on skill development/ employability/entrepreneurship

Isolation and identification of mutants in bacteria
Construct genetic make up
Induce mutation and understand repair systems in living organisms

Pedagogy

Chalk and talk, PPT, Group discussion, Seminar, Screening of educational videos and quiz

Course Learning Outcomes (CLO)

On the completion of the course the student will be able to

CLOs	Course Learning Outcome	Knowledge Level
CLO1	Outline the history of microbial genetics and mutation	Up to K2
CLO2	Delineate the basic concepts of bacterial genetics	Up to K3
CLO3	Predict the significance of phage in genetics	Up to K3
CLO4	Interpret the roles of transposable elements in microorganisms	Up to K4
CLO5	Elaborate the mechanisms of gene expression in microbes	Up to K4

K1 –Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving Problems
K4 – Examining, analyzing, presentation and make interferences with evidences

Mapping of Course Learning Outcome with Programme Specific Outcome

	PSO1	PSO2	PSO3	PSO4	PSO5
CLO1	3	3	2	3	3
CLO2	2	2	2	2	2
CLO3	2	2	3	2	3
CLO4	2	3	2	2	2
CLO5	2	2	2	3	2

Advance application – 3 Intermediate level – 2 Basic level – 1

Mapping of Course Outcome with Programme Outcome

	PO1	PO2	PO3	PO4	PO5
CLO1	2	1	2	2	1
CLO2	2	2	2	2	3
CLO3	2	2	1	1	2
CLO4	2	2	2	2	2
CLO5	3	2	2	2	2

Advance application – 3 Intermediate level – 2 Basic level – 1

Learning Outcome Based Education & Assessment (LOBE)
Blue Print
Articulation Mapping – K Levels with Courses Learning Outcomes (CLOs)

S. No.	CLOs	K-Level	Section A		Section B		Section C (Either / or Choice)	Section D (Open Choice)
			MCQs		Short Answers			
			No. of Questions	K-Level	No. of Questions	K-Level		
1.	CLO 1	Up to K2	2	K2 & K2	1	K1	2 (K1&K1)	1(K2)
2.	CLO 2	Up to K3	2	K3 & K3	1	K1	2 (K3&K3)	1(K3)
3.	CLO 3	Up to K3	2	K3 & K3	1	K2	2 (K2&K2)	1(K3)
4.	CLO 4	Up to K4	2	K4& K4	1	K2	2 (K4&K4)	1(K4)
5.	CLO 5	Up to K4	2	K1& K1	1	K3	2 (K4&K4)	1(K4)
No. of Questions to be asked			10		5		10	5
No. of Questions to be answered			10		5		5	3
Marks for each Question			1		2		5	10
Total Marks for each Section			10		10		25	30

K1 –Remembering and recalling facts with specific answers
K2 – Basic understanding of facts and stating main ideas with general answers
K3 – Application oriented – Solving Problems
K4 – Examining, analyzing, presentation and make interferences with evidences

Distribution of Section-wise Marks with K Levels

K Levels	Section A (No Choice)	Section B (No Choice)	Section C (Either/or)	Section D (Open Choice)	Total Marks	% of Marks without choice	Consolidated
K1	2	4	10	-	**16**	13.33	**35 %**
K2	2	4	10	10	**26**	21.67	
K3	4	2	10	20	**36**	30	**30%**
K4	2	-	20	20	**42**	35	**35%**
Total Marks	10	10	50	50	**120**	100.00	**100%**

K1 –Remembering and recalling facts with specific answers

K2 – Basic understanding of facts and stating main ideas with general answers

K3 – Application oriented – Solving Problems

K4 – Examining, analyzing, presentation and make interferences with evidences

LESSON PLAN

UNITS	DESCRIPTION	STAFF	HOURS	MODE
I History and Mutation	a) History of microbial genetics. Mendel's laws of heredity.		2	Chalk and Talk
	b) Mutations and genetic analysis		2	
	c) Useful phenotypes in bacteria and phage		2	
	d) Luria and Delbruck experiment		3	
	e) Newcombe-Isolation of Auxotrophic mutants		2	
	f) Positive and negative selection of mutants		2	
	g) Complementation-Allelism and cis/trans tests. Population genetics.		2	
II Bacterial Genetics	a) Bacterial conjugation: F+, F- Hfr strains		2	Chalk and Talk
	b) Genetic mapping with Hfr crosses.		2	
	c) F- prime factors		2	
	d) Complementation test using F-prime factors-conjugation in *Streptomyces*		2	
	e) Role of Pheromones in plasmid transfer in *Enterococcus faecalis*		2	
	f) Transformation - definition – competence induction - mechanism of DNA uptake in *E.coli*		2	
	g) mechanism of DNA uptake in *Bacillus sp* and *Haemophilus sp*		1	
	h) Recombination and its mechanisms		2	

UNITS	DESCRIPTION	STAFF	HOURS	MODE
III Phage Genetics	a) Phage biology - virulent and temperate bacteriophages (T7, M13 and P1)		3	Chalk and Talk & PPT
	b) gene expression of lambda phage during lytic and lysogenic cycles		2	
	c) phage crosses, recombination and complementation tests with phages		2	
	d) T4 RII locus mapping		2	
	e) Generalized transduction and specialized transduction		2	
	f) Co-transduction		2	
	g) Mapping of bacterial markers		2	
IV Transposable Elements	a) Contributions of Barbara McClintock.		3	PPT & Chalk and Talk
	b) Transposable genetic elements – IS elements, transposons and their types (Tn3, Tn5, Tn9, Tn10 and μ phage)		3	
	c) Identification of transposons.		3	
	d) Mechanism of transposition		3	
	e) Transposable elements in eukaryotes –maize, AC and DS elements, spm, dspm, p and copia elements in *Drosophila* and retro transposons		3	
V Gene Expression	a) Regulation of gene expression- negative regulation (*lac* operon).		3	PPT
	b) Regulation of gene expression- negative regulation (*gal* operon).		3	
	c) Positive regulation (*trp* operon).		2	
	d) Positive regulation (*ara* operon).		2	
	e) Role of RNA molecules in gene regulations.		2	
	f) Regulatory mechanisms in *E.coli*- catabolite regulation, tRNA and rRNA regulation (stringent control).		3	
Total			**75 Hours**	

Course designers

1. Mr. P. Sasikumar