Master of Science (Microbiology)
M. Sc. (Microbiology) Semester II

Course Code	PS02CMIC52	Title of the Course	Microbial Genetics
Total Credits of the Course	04	Hours per Week	04

Course Objectives:	• To gain insights molecular basis of mutation and the pathways that safeguard DNA from damage. • To learn about naturally occurring plasmids, plasmid copy number regulation and mechanism of segregation in daughter cells • To learn about the classical methods of studying genetics in bacteriophages as well as fungi. • To learn about molecular mechanisms of recombination in bacteria and eukaryotes • To gain in depth knowledge about methods of horizontal gene transfer in bacteria and their application in genetics • To learn biology of Agrobacterium, restriction modification systems and transposons.

Course Content

Unit	Description	Weightage* (%)
1.	Mutation, DNA damage and Repair Spontaneous mutations (Random v/s Adaptive nature of mutation; Mutation rate and its determination, Types of DNA damage and their consequences (spontaneous and chemical induced deamination, radiation induced DNA damage, loss of nitrogen bases, alkylation, intra and inter strand cross linking). DNA repair pathways (Mis-match repair in prokaryotes and eukaryotes, Nucleotide excision repair in prokaryotes and in eukaryotes, base excision repair, recombinational repair, SOS pathway, specific repair of oxidative DNA damage, repair of pyrimidine dimers, repair of alkylation induced damage and adaptive response and other specific repair mechanisms).	25%
2.	Plasmid Biology (Types of plasmids, compatibility, regulation of plasmid copy number and plasmid segregation) Phage genetics (T-series, complementation and Fine structure analysis, biology of lambda phages)	25%

	Recombination (Types, Models of homologous recombination, Molecular mechanism of homologous, Homologous recombination in eukaryotes, mating type switching, Site specific recombination and its biological significance) Fungal Genetics (Tetrad analysis and Mitotic recombination)	
3.	Transformation (Natural transformation in Bacillus subtilis, Streptococcus pneumonia and Haemophilus influenza). Transformation by inducing artificial competence, Gene linkage and mapping by transformation. Transduction (Generalized transduction in P22, P1, T4 and Mu bacteriophages, homologous recombination with recipient's chromosome, measuring transduction (co-transduction of markers, marker effects, abortive transduction, transduction of plasmids). Applications of generalized transduction, Specialized transduction and its applications. Conjugation (F-factor mediated Conjugation in E. coli, Hfr conjugation and chromosomal transfer, F-prime conjugation and merodiploids, Conjugation of fertility inhibited F-like plasmids, Non conjugative mobilizable plasmids, chromosomal mobilization of non-F plasmids, Plasmid based conjugation in other bacteria (Salmonella, Pseudomonas, Streptomyces and streptococcus, Interrupted mating and conjugational mapping)	**25%**
4.	Agrobacterium genetics: Ti plasmid, Interkingdom gene transfer (Key early experiments, vir regulon, protein secretion apparatus, conjugation model of T-DNA transfer, Integration products) Restriction modification systems: Types of RM systems, Role of RM systems, salient features and insights into evolution of diverse types of Restriction endonucleases and Methyl transferases, Regulation of RM systems. Transposable elements: Types of bacterial transposable elements; Structure, genetic organization and mechanism of transposition of Tn5, Tn3, phage Mu, Tn7, IS911, Integrons, Retrotransposons, conjugative and mobilizable transposons, Assays of transposition.	**25%**

Teaching-Learning Methodology	Topics will be taught and discussed in interactive sessions using conventional black board and chalk as well as ICT tools such as power point presentations and videos. Practical sessions will be conducted in a suitably equipped laboratory either individually or in groups depending on the nature of exercise as well as availability of infrastructure. Course materials will be provided from primary and secondary sources of information.

Evaluation Pattern		
Sr. No.	Details of the Evaluation	Weightage
1.	Internal Written / Practical Examination (As per CBCS R.6.8.3)	15%
2.	Internal Continuous Assessment in the form of Practical, Viva-voce, Quizzes, Seminars, Assignments, Attendance (As per CBCS R.6.8.3)	15%
3.	University Examination	70%

Course Outcomes: Having completed this course, the learner will be able to	
1.	describe the types of mutations, mode of action of different mutagens, molecular basis of spontaneous mutations and the pathways existing in cells to safe guard its DNA against such damages.
2.	explain how copy number of naturally occurring plasmids is regulated and the molecular basis of their stability in cell.
3.	explain the models proposed to explain the molecular mechanism of recombination in bacteria and eukaryotes.
4	analyse tetrads and perform gene mapping in fungi.
5	describe the different modes of gene exchange in bacteria and perform mapping using these methods.
6	explain the biology of Agrobacterium tumefaciens and describe the interkingdom gene transfer in detail.
7	explain the biology of Restriction Modification systems in detail.
8	discuss different types of bacterial transposons, their genetic organization and mode of transposition.

Suggested References	
Sr. No.	References
1	Watson, J. D., Tania, A. B., Stephen, P., B., Alexander, G., Michael, L., Richard, L., (2017). Molecular Biology of the Gene. 7th Edn. Pearson Education, United Kingdom
2	Henkin, T. M., Peters, J., E., (2020). Snyder and Champness Molecular Genetics of Bacteria. 5th Edn. ASM Press, Washington, DC.
3	Tropp, B. E., (2012). Molecular Biology: Genes to Proteins. 4th Edn. Laxmi

	Publications, New Delhi
4	Snustad, P. D., Simmons, M., J., (2011). Principles of Genetics. 6th Edn. Wiley Publications, New Jersey
5	Streips, U. N., & Yasbin, R. E. (Eds.). (2002). *Modern microbial genetics* (Vol. 344). New York: Wiley-Liss.
6	Krebs, J. E., Goldstein, E. S., & Kilpatrick, S. T. (2017). *Lewin's genes XII*. Jones & Bartlett Learning.
7	Maloy, S. R., Cronan, J. E., & Freifelder, D. (1994). *Microbial genetics*. Jones & Bartlett Learning.
8	Stent, G. S., & Calendar, R. Molecular Genetics. 1978.

On-line resources to be used if available as reference material
Relevant review articles / research papers / handouts of latest development in the subject.