Title of the Course: MICROBIAL GENETICS [T]

Course Code: MIC-502
Number of Credits: 3, Theory
Contact hours: 45
Effective from Academic Year: 2022-23

Prerequisites	It is assumed that students have basic knowledge of Mendelian genetics, structure of DNA and RNA, Prokaryotic and eukaryotic genome organisation, mutation concept, basic knowledge about replication, transcription.	
Objective:	This course develops concept of Classical Mendelian genetics and deviation from Mendelian principles, Microbial genome organization (Prokaryotic and Eukaryotic), Viral Genetics, Mutagenesis and Bacterial plasmids. Understanding the concepts of replication, transcription and their regulation in prokaryotes and microbial eukaryotes.	
Content:		
1.	**Microbial genome organization, gene regulation and genetic transfer**	**(15)**
1.1	Classical Mendelian genetics; deviation from Mendelian principles; Origin of mitochondria and plastids – Endosymbiotic theory, DNA in Mitochondria and plastids, Mitochondrial and plastid genes inherited by Non-Mendelian mechanism; Introduction to epigenetic inheritance.	**4**
1.2	Prokaryotic & Eukaryotic genome size & structure, exceptions in prokaryotic genome (linear chromosome in *Borrelia burgdorferi*); Introduction to synthetic genome (*Mycoplasma genitalium*), pseudogenes and their significance, C-value paradox, polyploidy in prokaryotes. Prokaryotic and Eukaryotic replication, transcription and regulation. Structure of Prokaryotic genes (lac and trp operon) and Eukaryotic Genes (interrupted Genes, intron splicing mechanisms). Microbial gene transfer (Conjugation, transformation, transduction).	**8**
1.3	Genomic organization, replication and regulation of Lytic and Lysogenic Phages - T4 and Lambda Phage	**3**
2.	**Genomic Rearrangements and Mutagenesis**	**(15)**
2.1	Mechanism of General and programmed DNA rearrangements, Antigenic and phase variation in bacteria. Transposons: IS elements – Composite transposons (Tn3, Tn10), Ty, Copia and P type, Mechanism of transposition. Role of transposons in DNA rearrangements, microbial genome evolution and drug resistance. Deletion, duplication, inversion, translocation. Integrons and Genomic islands - pathogenicity islands.	**6**

2.2	**Mutagenesis, mutation and mutants**: Somatic and germinal mutation, spontaneous and induced mutations, site directed mutagenesis using PCR and cassette mutagenesis, and random mutagenesis. Tautomeric shift, transition, transversion; Concept of clustered regularly interspaced short palindromic repeats (CRISPR) - Cas9. **DNA Damage:** Thymine dimer, apyrimidinic site and apurinic site, cross linking, deamination of base, base mismatch. **Types of mutations:** silent mutation, missense mutation, nonsense mutation, Read through mutation, frameshift- insertion and deletion mutation, suppressor mutation, leaky mutation. **Mutagenic chemicals and radiations and their mechanism of action**: Base analogues (5-Bromouracil and 2-amino purines), alkylating agents (EMS, NTG), Intercalating agents (acridines, Acriflavins), Hydroxylamine; mutagenic radiations- UV, X-rays and gamma rays. Ames test; Auxotrophy. Importance of mutations.	**9**
3.	**Fungal Genetics**: Yeast - *Saccharomyces cerevisiae/ Schizosaccharomyces pombe* and *Neurospora* genomes as model genetic systems; Chromosome replication, 2µ plasmid, Yeast Artificial Chromosomes (YAC), tetrad analysis, genetic compatibility and non-compatibility genes, heterokaryosis, Parasexuality, Petite mutants of yeast, Killer yeast.	**(07)**
4.	**Bacterial plasmids**: Types of plasmids, F plasmids and their use in genetic analysis-F^+/Hfr cells/ F'cells, Col plasmids, R plasmids-plasmids with genes encoding metal resistance and antibiotic resistance - efflux pump/MDR bacteria, degradative plasmids, Ti plasmid. Replication in plasmids. Concept of copy number (Col Plasmid) and compatibility; Bacterial plasmids as research tools.	**(08)**
Pedagogy:	Lectures/tutorials/assignments	
References/ Readings	Alberts, B., Johnson, A., Lewis, J., Morgan, D., Raff, M., Roberts, K. and Walter, P., Molecular Biology of the Cell, Garland Science. (2014)	
	Birnboim, H.C. and Doly, J., (1979) A rapid alkaline extraction procedure for screening recombinant plasmid DNA. Nucleic Acid Research, 7: 1513-1523.	
	Dale, J.W. and Park, S.F., Molecular Genetics of Bacteria, John Wiley (2010).	
	Freifelder, D. Molecular biology, a comprehensive introduction to prokaryotes and eukaryotes. JANE'S PUBLISHING INC., BOSTON, MA(USA). (1983).	
	Gardner, E.J., Simmons, M.J. and Snustad, D.P., Principles of Genetics, John Wiley & Sons. (2006).	
	Green, M. R. and Sambrook, J., Molecular Cloning: A laboratory	

	manual, Cold Spring Harbour Laboratory Press, New York. (2014).	
	Holmes, D.S. and Quigley, M., A rapid boiling method for the preparation of bacterial plasmids. Anal Biochem., 114(1): 193-197. (1981)	
	Krebs J.E., Lewin B., Goldstein E.S. and Kilpatrick, S.T., LEWIS Genes XI, Jones and Bartlett Publishers. (2014).	
	Maloy, S. R., Cronan, J. E. and Freifelder, D., Microbial Genetics, Jones and Bartlett Publishers.	
	Peter, J. R., *i*Genetics: A Molecular Approach, Pearson Education. (2016).	
	Sambrook, J., Fritsch, E. F. and Maniatis, T., Molecular Cloning: A Laboratory Manual, Cold Spring Harbor Laboratory, New York. (1989).	
	Streips, U.N. and Yasbin, R.E., Modern Microbial Genetics, John Wiley. (2004).	
	Snyder, L., Peters, J. E., Henkin, T. M. and Champness, W., Molecular Genetics of Bacteria, ASM Press. (2013)	
	Trun, N. and Trempy, J., Fundamental Bacterial Genetics, John Wiley & Sons. (2003)	
	Watson, J. D., Baker, T. A., Bell, S. P., Gann, A., Levine, M., Losick, R. Molecular Biology of the Gene, Pearson/Benjamin Cummings. (2007).	
Course Outcomes	● Construct the relation between genetic constituents with phenotypic characteristics. ● Explains principles of prokaryotic and eukaryotic genetics, and viral genetics. ● Apply mutagenesis, mutation and mutants for the development of strains. ● Categorize the bacterial and eukaryotic plasmids and mobile elements.	