Name of the Program: M.Sc. Marine Microbiology
Course Code: MMI-512
Title of the Course: Microbial Genetics and Gene Regulation
Number of Credits: 03
Effective from AY : 2022 - 23

Prerequisites for the course:	It is assumed that the students have a basic knowledge of DNA (structure and replication), Prokaryotic and eukaryotic genome organisation, mutation concept, basic knowledge transcription and translation.	
Objective:	This course develops concepts in molecular biology: DNA packaging, DNA damage and repair, gene structure, expression and regulation in both prokaryotes and eukaryotes	
Content:	**Module I** Chromosomes, Genomes and its evolution: Introduction to microbial genetics. DNA structure and its fundamental functions. Chromosomal DNA and its packaging in the chromatin fibre. Chromatin structure, structural features (Telomere, Centromere and Repetitive sequences) of chromosomes and their functions. Satellite DNA, Repetitive DNA. Histone modifications. Genomic islands. Structural chromosomal aberrations and their significance: Deletion, duplication, inversion, translocation. Aneuploidy and polyploidy. Gene duplication and mutations. **Module II** DNA Damage, DNA Repair and Recombination: Types of DNA damage (spontaneous and induced DNA damage). Mutagenesis: Somatic and germinal mutation, site specific using PCR/ cassette mutagenesis, and random mutagenesis. Types of mutation: silent, missense, nonsense, Read through, frameshift- insertion and deletion mutation, translocation, Inversion, suppressor mutation. Mutagenic chemicals and radiations and their mechanism of action: Base analogues (5-Bromouracil and 2-amino purines), EMS, acridines, NTG, Hydroxylamine; mutagenic radiations- UV, X-rays and gamma rays. Ames test; Auxotrophy. Mechanisms/pathways to remove damaged DNA: Excision repair, mismatch repair, recombination repair in *E. coli* and SOS Repair. Role of RecA in DNA damage repair, Photoreactivation repair in E. coli involving photolyase. Mechanisms of Genetic Recombination:	15 hrs 15 hrs

	General and site-specific recombination. Heteroduplex DNA formation (Homologous recombination). Holliday junctions. Synaptonemal Complex, Bacterial RecBCD system and its stimulation of chi sequences. **Module III** Genomic rearrangements, Gene structure and control of gene expression in Prokaryotes and Eukaryotes: 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 and microbial genome evolution. An overview of Gene expression control, DNA binding motifs in gene regulatory proteins, genetic switches and their role in control of gene expression. Lac operon, tryptophan operon, post-transcriptional controls-transcriptional attenuation, Riboswitches, Alternate splicing, RNA editing, RNAi.	15 hrs
Pedagogy:	Lectures/ assignments/ self-study	
References/ Readings:	1. Gardner E.J., Simmons M.J. & Snustad D.P. (2015). Principles of Genetics (7th edn) John Wiley & Sons. NewYork. 2. Krebs J. E., Lewin B., Goldstein E. S. & Kilpatrick S.T. (2018). LEWIS Genes XII (1st edn) Jones and Bartlett Publishers. Burlington. 3. Maloy S.R., Cronan J.E. & Freifelder D. (1994). Microbial Genetics (2nd edn) Jones and Bartlett Publishers. Boston. 4. Streips U.N. & Yasbin R.E. (2002). Modern Microbial Genetics (2nd edn). John Wiley & Sons. NewYork. 5. Peter J.R. (2010). iGenetics: A Molecular Approach (3rd edn) Pearson Education. San Francisco. 6. Alberts B., Johnson A., Lewis J., Morgan D., Raff M., Roberts K.& Walter, P. (2015). Molecular Biology of the Cell (J. Wilson, & T. Hunt, Eds.) (6th edn). W.W. Norton & Company. NewYork. 7. Twyman R.M. (1998). Advance Molecular Biology: A Concise Reference (W. Wisden, Ed.) (1st ed.). Garland Science. London. 8. Davis L.G., Dibner M.D. & Battey J. F. (1986). Basic Methods in Molecular Biology, Elsevier. Netherlands.	

Course Outcomes:	1. Understand gene structure and mutations in prokaryotes and eukaryotes. 2. Compare positive and negative gene expression and regulation systems. 3. Differentiate various repair mechanisms of DNA damage. 4. Discuss the significance of mutagenesis in molecular research and microbial evolution.	