Principle of Genetics
3 Credit course (2:1:0)

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Unit 1: Basic Principles of Inheritance/Heredity

- **Genetics - The Study of Biological Information:** DNA as genetic material, central dogma, model genetic organisms (Saccharomyces cerevisiae, Arabidopsis thaliana, Drosophila melanogaster)
- **Mendelism:** Laws of Inheritance (Law of segregation, law of independent assortment and law of dominance)
- **Extension of Mendelism**: Co-dominance and incomplete-dominance, Allelic variations and gene function
- **Chromosome theory of heredity**: Sex linked inheritance, sex influenced traits, dosage compensation of X linked traits

Unit 2: Genetic recombination and exchange

- **Linkage, Recombination and Chromosome mapping:** Complete Linkage, incomplete linkage, Crossing over with linked genes, Physical basis of recombination, gene mapping with recombinant frequency, Construction of genetic map with a two-point test cross.
- **Fundamentals of bacterial genetics:** Plasmid and Episomes, Mutant genes in bacteria, Uni-directional gene transfer in bacteria, Mechanism of genetic exchange in bacteria (transformation, conjugation and transduction); bacterial recombination (homologous, site specific)
- **Fundamentals of yeast genetics:** Mating types, mutant generation and analysis of genetic interactions (deletion, complementation)
- **Fundamentals of Viral genetics:** Lytic cycle, Lysogenic cycle, Techniques for the study of Bacteriophages, Gene Mapping in Phages, Transduction: Using Phages to map bacterial genes.

Unit 3: Basic structure of Chromosomes and transposable elements

- **Molecular structure of chromosome:** Structure of DNA and RNA, double helix of DNA, Negative supercoils of DNA
- **Chromosome structure in Prokaryotes** (Example: *E. coli*), genome organisation in prokaryotes, genome packaging (nucleoid, proteins involved in DNA supercoiling) **and Viruses (Example:** Lambda phage)
- **Chromosome structure in Eukaryotes**: Chemical composition of chromosome, Three levels of DNA packaging in chromosome (nucleosome, supercoiling-chromatin fibre, metaphase-chromosome), chromosome

organisation (centromere, kinetochores, telomeres), Giant chromosomes (polytene, lampbrush)

- **Transposable elements (TE):** General characteristics of TE, Structure of TE (Bacteria and Eukaryotes), Mechanism of transposition, Mutagenic effects of transposition.

Unit 4: Potential application of genetics

- **Techniques of molecular genetics:** Cloning, molecular analysis of DNA, RNA and protein,
- **Application of recombinant DNA technology:** Production of recombinant proteins/vaccines (Example: Insulin/human growth hormone), Transgenic Plant, Transgenic animals.
- **Molecular diagnosis of human disease** (Example: Huntington's disease, cystic fibrosis), Human gene therapy, DNA profiling.
- **Reverse Genetics:** Dissecting Biological Processes by Inhibiting Gene Expression (Knock out mutation in the mouse), Conventional Karyotyping and Fluorescence in situ hybridization (FISH).

Suggested reading:

- Principles of Genetics, Snustad and Simmons, 8th Edition (2012)
- An introduction to Genetic Analysis, Griffith AF et al., - Freeman
- Genetics: A Conceptual Approach, Pierce BA – Freeman
- Concepts of Genetics, Klug WS and Cummings MR – Prentice Hall
- Genetics, Strickberger MW – Prentice HallGene Cloning and DNA Analysis, - An Introduction (2001) Brown T. A., Blackwell
- Molecular Cloning (2001) - A Laboratory Manual (3-Volume Set) Sambrook J. et al., CSHL Press
- Principles of Gene Manipulation and Genomics (2001) - Primrose S. B. & Twyman R. M, Blackwell Publishing.