Course Code	Course Name	Credits
26BY512	GENETICS, PLANT BREEDING AND EVOLUTION	04

Course Objectives

- To train the students to accomplish mastery in the field of genetics and basic techniques of plant breeding.
- Analyze mechanisms of sex determination, linkage, crossing over and extrachromosomal inheritance, and interpret genetic relationships through pedigree and linkage mapping.
- Apply principles of population and quantitative genetics in crop improvement.
- Evaluate concepts of plant breeding and theories of evolution.

Learning Outcomes

Upon successful completion of this course it is intended that a student will be able to:

- Describe Mendelian laws, perform genetic crosses and interpret inheritance patterns.
- Explain sex determination systems, analyze linkage and recombination data, and construct linkage maps while interpreting pedigree charts.
- Calculate gene frequencies, assess population genetic structures and evaluate the role of selection and heritability in crop improvement programs.
- Demonstrate understanding of plant breeding techniques and evolutionary principles and assess their applications in crop development and biodiversity conservation.

Unit 1 - Mendelian and Extension of Mendelian Genetics (12 Hrs.)

Mendel's work on transmission of traits, Monohybrid cross, Dihybrid cross, Test and back cross, Trihybrid cross, Chromosomal theory of inheritance, Incomplete or partial dominance, Codominance, Multiple alleles, Lethal alleles, Gene interaction, Pleiotropy, Genetic anticipation, Penetrance and expressivity, Pedigree analysis.

Unit 2 - Sex Determination (12 Hrs.)

Chromosomal and environmental sex determination mechanisms with examples, Dosage compensation, Random X chromosome inactivation, Linkage and crossing over, Construction of linkage map, Recombination, Cytological basis of crossing over, Extrachromosomal inheritance.

Unit 3 - Population Genetics (12 Hrs.)

Concepts of a population, Gene pools of cultivated crops, calculating gene frequency, Hardy–Weinberg equilibrium, Factors affecting changes in gene frequency, Modes of selection, Population improvement, Quantitative genetics, Gene action and types, Types of heritability, Mating designs for random mating populations.

Unit 4 - Plant Breeding (12 Hrs.)

Types, objective, importance and future of plant breeding, Basic steps in plant breeding, Achievements of modern plant breeders, Technologies/techniques associated with creation of variation, Centers and models of plant domestication, Plant genetic resources, Germplasm collection and conservation, Breeding self-pollinated species, Breeding cross-pollinated species, Breeding clonally propagated species, Mutagenesis in plant breeding, Molecular breeding.

Unit 5 - Evolution (12 Hrs.)

Evidences for evolution, Evolutionary time scale, Theories of evolution, Neo-Darwinian synthesis, Microevolution, Macro evolution, Species concept, Isolation, Speciation.

Reference Books:

1. Acquaah, G. (2012). Principles of plant genetics and breeding (2nded.). John-Wiley & Sons. Ltd. Publication.
2. Atherly, A. G., Girton, J. R., & McDonald, D. M. (1999). The science of genetics. Saunders College Publications, Harcourt Brace.
3. Ghahal, G. S., & Gosal, S. S. (2002). Principles and procedures of plant breeding. Narosa Publishing House.
4. Klug, W. S., Cummings, M. R., Spencer, C. A., & Palladino, M. A. (2016). Concepts of genetics (11th ed., Global ed.). Pearson Education.
5. Ridley, M. (2004). Evolution (3rd ed.). Blackwell Publishing.
6. Shukla, R. S., & Chandel, P. S. (1996). Cytogenetics, evolution and plant breeding. S. Chand & Company.
7. Sproule, A. (1998). Charles Darwin: Scientists who have changed the world. Orient Longman.
8. Tamarin, R. H. (2002). Principles of genetics (7th ed.). Tata McGraw Hill.
9. Verma, P. S., & Agarwal, V. K. (1999). Concepts of evolution. S. Chand & Company.