University of the Punjab,
Lahore

Course Outline
Semester – II

Programme	BS Botany	Course Code	Bot-118	Credit Hours	2
Course Title	**Fundamentals of Genetics and Evolution (Theory)**				

Introduction

This course is designed to provide a comprehensive understanding of two foundational pillars of biology: genetics and evolutionary theory. This course includes concepts regarding inheritance patterns, recombination in bacteria, linkage and mapping, extranuclear inheritance, developmental and population genetics.

Learning Outcomes

On the completion of the course, the students will:

- To impart basic knowledge of genetics and how genes are carried from one generation to the next, and their subsequent impact on evolution
- To enable the students to understand the structural and functional basis of genes and proteins and their mutual interactions
- To enable the students to understand various DNA manipulations at the molecular level

Course Contents

- Introduction, scope and brief history of genetics, Mendelian inheritance; Laws of segregation and independent assortment,
- Extension in Mendelian Inheritance, Dominance, incomplete dominance, and Co Dominance, Allozymes, and Isozymes, back cross, test cross;
- Sex linked inheritance, Sex Linkage in Drosophila and Man (Color blindness), XO, XY, WZ mechanisms, Sex limited and sex-linked characters, Sex determination.
- Penetrance and Expressivity Allelic and Non-Allelic Interactions i.e. Epistasis, Pleiotropy
- Linkage and crossing over; Linkage groups, Construction of linkage maps, Detection of linkage.
- Recombination; DNA replication; Nature of gene, Transcription, Translation, Genetic code; Regulation of gene expression (e.g. lac operon).
- Transmission of genetic material in bacteria; conjugation and gene recombination in co-transduction and transformation
- The process and concept of evolution, theories of origin in life, Historic idea of evolution, sources of variability, different mechanisms of gene change,
- Evolutionary perspective explained by Hardy-Weinberg Equilibrium, Introduction to Quantitative Genetics, Evolution due to change in gene and Genotype frequencies, Role of gene mutation in evolution, Role of genetic drift and mutation in evolution Role of natural selection in evolution Role of Random mating and population size in evolution
- The Extranuclear Genome: Variegation in leaves of higher plants, mitochondrial genes in yeast, extra genomic plasmids in eukaryotes

Teaching Learning Strategies
• Lectures • Group Discussion • Laboratory work • Seminar/ Workshop • Problems practice to clear genetics concepts
Assignments: Types and Number with Calendar
• Students are expected to describe, apply and integrate the basic concepts of Genetics and Evolution, as well as Structure and Functions of different genes • This will enable them qualify for basic to moderate level jobs involving general knowledge of Biology. • The obtained knowledge shall also enable the students to enter into various entrepreneurial activities involving general introduction to Genetics.

Programme	BS Botany	**Course Code**	**Bot-118L**	**Credit Hours**	1
Course Title	**Fundamentals of Genetics and Evolution (Lab)**				

Lab Course Contents
• Mitosis and Meiosis diagrams showing chromosomal Inheritance • Checker Board, Gamete formations, Monohybrid and dihybrid Patterns of Inheritance. • Proof of Ratios 9:3:3:1, 3:1 • Test Cross ratios, • Numerical problems leading to the discovery of Epistasis and Its types • Change in segregation Ratios due to incomplete dominance • Testing Hardy Weinberg Equilibrium • Estimation of Genetic distances to create a linkage map. • Three-point test cross, and gene order, Interference • Estimation of Gene frequencies in populations • Estimation of Genotype frequencies in populations
Textbooks and Reading Material
1. Alberts, B., Johnson, A., Lewis, J., Raff, M., Roberts, K., & Walter, P. (2002). Molecular biology of the cell (5th ed.). New York, NY: Garland Science. 2. Campbell, N. A., & Reece, J. B. (2008). Biology (8th ed.). San Francisco, CA: Pearson Education. 3. Freeman, S., & Herron, J. C. (2007). Evolutionary analysis (4th ed.). Upper Saddle River, NJ: Prentice Hall. 4. Hartl, D. L., & Jones, E. W. (2009). Genetics: Analysis of genes and genomes (7th ed.). Sudbury, MA: Jones and Bartlett Publishers. 5. Ridley, M. (2004). Evolution (3rd ed.). Malden, MA: Blackwell Publishing. 6. Barton, N. H., Briggs, D. E. G., Eisen, J. A., Goldstein, D. B., & Patel, N. H. (2017). *Evolution*. Oxford University Press. 7. Pierce, B. A. (2012). *Genetics: A conceptual approach* (4th ed.). W.H. Freeman and Company.

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