

# **ADVANCED PLACEMENT TEST**

## **MODULE DESCRIPTION**

### **LSM1102 - Molecular Genetics**

This module covers topics on (i) the patterns of inheritance, (ii) the molecular properties of genes and chromosomes, (iii) transcription and translation, (iv) genetic methods and technology, and (v) genetic analysis of individuals and populations. This will include an in-depth understanding of mendelian patterns of inheritance and variations that could occur due to multiple alleles, lethal genes, chromosomal variations, linkage, gene interaction and other genetic phenomena. Emphasis is placed on the understanding of the underlying molecular and biochemical basis of inheritance. Quantitative and population genetics will also be discussed with the emphasis of understanding the processes and forces in nature that promote genetic changes.

#### **Syllabus**

1. Overview of Genetics and Cellular Organization
2. Reproduction and Chromosome Transmission (Cellular Division: Mitosis and Meiosis)
3. Genetic Transfer and Mapping Analysis in Microorganisms
4. Chromosome Organization, Molecular Structure and Recombination
5. Gene Transcription and RNA Processing
6. Translation of mRNA
7. Molecular genetic methods (genetic screening, recombinant and transgenic technologies, RNAi, reporter tagging etc)
8. New genetic technology (genome editing, next generation sequencing, omics)
9. Model organisms in genetic studies
10. Mendelian Genetics + Sex Chromosomes and Sex Linkage
11. Modes of Inheritance and Pedigree Analysis
12. Variations to Mendelian Genetics, Penetrance, Expressivity, Pleiotropy and Linkage
13. Population Genetics – Hardy-Weinberg Equilibrium, Mutation and Selection, Fitness, Factors Maintaining Polymorphism e.g., Over-dominance
14. Quantitative Genetics and Genetic Epidemiology

#### **Recommended Text**

1. *Genetics. Analysis & Principles* by R J Brooker. Addison Wesley / McGraw-Hill
2. *Principles of Genetics* by Snustad and Simmons. John Wiley. (3rd Edition)

## LSM1401- Fundamentals of Biochemistry

This module seeks to provide the student with an understanding of the fundamental aspects of biochemistry required by non-Life Sciences majors. The applications of biochemistry in the fields of biology, chemistry, environmental sciences, pharmacy, and engineering are emphasised. The module covers the structures and functions of biomolecules with selected topics in cell biology, cellular metabolism, microbial systems, and molecular genetics. From this module, the student is expected to have a sufficient knowledge of fundamental life processes and relate this knowledge to industry as well as to everyday life. The student should also be well prepared to read other advanced modules with biochemistry as a prerequisite.

### Syllabus

1. Life and Aqueous Solutions: Chemical processes as an integral part of a living cell. Acid-base reactions and concept of buffering. pH and buffers – maintenance of biological systems in engineering and pharmaceutical processes.
2. Cell Biology: Diversity of living systems. Organisation, structure and functions of cells – prokaryotes, eukaryotes, plant, and animal cells. Cell membrane and transport. Cell cycle. Cell growth and nutritional needs. Overview of growing cells – batch and continuous culture. Industrial uses of microbes and other cell types.
3. Biomolecules – Nucleic Acid Structure and Function: Structure and function of nucleic acids. Flow of genetic information – replication, transcription, and translation. Manipulation and application of genetic information. Industrial application of recombinant DNA.
4. Biomolecules – Protein Structure and Function: Amino acids, peptides, and proteins. Chemical bonds and functional groups. Proteins as enzymes. Enzyme properties and kinetics. Industrial applications of proteins and enzymes. Immobilisation of proteins and enzymes.
5. Biomolecules – Lipid Structure and Function: Structural diversity and functions. Lipids of commercial importance.
6. Biomolecules – Carbohydrate Structure and Function: From monomers to polymers. Energy for human and raw material for industries.
7. Cellular Metabolism: Concept of metabolic pathways. Diversity of metabolism. Production and utilisation of energy. Energy from lipids ( $\beta$ -oxidation). Glycolysis as model metabolic pathway. Fermentation. Citric acid cycle. Intermediary metabolism – large scale production of specific metabolites.

## Recommended Text

1. *Biochemistry* by Mary K. Campbell and Shawn O. Farrell, 6th Edition, 2009, Thomson Brooks/Cole.
2. *Cell Biology and Genetics* by Cecie Starr, Ralph Taggart, Christine Evers, and Lisa Star, 12th Edition, 2009, Thomson Brooks/Cole.
3. *Biochemistry: The Molecular Basis of Life* by Trudy McKee and James R. McKee, 3rd Edition, 2003, McGraw-Hill Higher Education.
4. *Biochemistry* by Jeremy M. Berg, John L. Tymoczko, and Lubert Stryer, 6th Edition, 2007, W.H. Freeman.
5. *Molecular Cell Biology* by Harvey Lodish, Arnold Berk, Chris A. Kaiser, Monty Krieger, Matthew P. Scott, Anthony Bretscher, Hidde Ploegh, and Paul Matsudaira, Sixth Edition, 2008, W.H. Freeman.
6. *Fundamentals of Biochemistry: Life at the Molecular Level* by Donald Voet, Judith G. Voet, and Charlotte W. Pratt, 3rd Edition, 2008, John Wiley.
7. *Biochemistry* by Reginald H. Garrett and Charles M. Grisham, 4th Edition, 2010, Thomson Brooks/Cole.
8. *Lehninger Principles of Biochemistry* by David L. Nelson and Michael M. Cox, 5th Edition, 2009, W.H. Freeman.