

## Course II: Cell and Molecular Biology (BSCZO102)

### Course Objectives:

1. To understand the structures and purposes of basic components of prokaryotic and eukaryotic cells, especially macromolecules, membranes, and organelles
2. To learn the cytological techniques, the structure and functions of various cellular components.
3. To understand how these cellular components are used to generate and utilize energy in cells and process of cell division.
4. To understand the fine structure of genetic materials and regulation of their action.
5. To know the chromosomal basis of genetic disorder, development and differentiation. Also, to know the importance of population genetics and nuances of genetic engineering and applied genetics.
6. Hereditary process, Chromosomal organization and importance of sex linked inheritance for man and other animals

### Syllabus

History and origin. Prokaryotic and Eukaryotic cell. Difference between Prokaryotic and Eukaryotic cell. History, Ultra structure, and chemical composition of plasma membrane (Lamellar-models, micellar models and fluid mosaic model). Functions of plasma membrane. History and structure, biogenesis and functions of mitochondria (Respiratory chain complex and Electron transport mechanism). History, structure, functions and importance Endoplasmic reticulum, Ribosome and Golgi bodies. History, structure, functions and importance of Lysosome, centriole and microtubules. History, structure, function and importance of Nucleus. History, types & functions of chromosomes. Giant chromosomes, Polytene chromosome and Lampbrush chromosome. Mitosis (cell cycle stages, cytokinesis) Meiosis (reproductive cycle stages, synaptonemal complex, recombination nodules) and comparison between meiosis and mitosis. Structure, functions and type of DNA, Watson and Crick's structural model of DNA, chemical composition of DNA, replication of DNA and recombinant DNA. Structure of RNA (primary, secondary and tertiary structure) and types of RNA (transfer RNA, messenger RNA, ribosomal RNA). Biosynthesis of m-RNA, t-RNA. Function and importance of RNA. Protein Synthesis and regulation: Protein Synthesis, mechanism (initiation, elongation and termination) of protein synthesis. Gene regulation (Operon hypothesis: regulator gene, promoter gene, operator gene, structural gene, repressor gene, co-repressor gene and inducer gene), regulation at transcription, regulation by gene arrangement and reversible phosphorylation, types of control mechanisms, regulation of gene activity in eukaryotes. Genetic Code: Properties of genetic code, codon and anti codon, The Wobble Hypothesis, Mutation and the triplet code.

## **UNIT SCHEDULE**

### **Block I: Cell biology or Cytology**

**Unit 1:** Cell type

**Unit 2:** Plasma membrane

**Unit 3:** Mitochondria

**Unit 4:** Endoplasmic reticulum, Ribosome, Golgi bodies

**Unit 5:** Lysosome, centriole, microtubules

**Unit 6:** Nucleus

**Unit 7:** Chromosomes

**Unit 8:** Cell division

### **Block II: Molecular Biology**

**Unit 9:** Structure and type of DNA

**Unit 10:** Structure of RNA

**Unit 11:** Protein Synthesis and regulation

**Unit 12:** Genetic Code

### **Suggested Readings:**

1. Lodish: Molecular Cell Biology (Freeman).
2. Rastogi, V.B.: Introductory Cytology, Kedarnath Ramnath.
3. Verma, P.S. & Agarwal, V.K.: Cytology, S. Chand & Co Ltd.
4. Hartl & Jones: Essential Genetics: A Genomic Perspective (2002, Jones & Bartlett).
5. Russell: Genetics (2002, Benjamin Cummings).
6. Snustad & Simmons: Principles of Genetics (2006, John Wiley).
7. Lewin: Genes IX (2008, Jones & Bartlett).

## **Cell and Molecular Biology (BSCZO102)**

### **UNIT WISE CONTENTS**

#### **Block I (Cell biology or Cytology)**

##### **Unit 1:** Cell type

History and origin. Prokaryotic and Eukaryotic cell. Difference between Prokaryotic and Eukaryotic cell.

##### **Unit 2:** Plasma membrane

History, Ultra structure, and chemical composition of plasma membrane (Lamellar-models, micellar models and fluid mosaic model). Functions of plasma membrane

##### **Unit 3:** Mitochondria

History and structure of mitochondria, biogenesis and functions of mitochondria (Respiratory chain complex and Electron transport mechanism).

##### **Unit 4:** Endoplasmic reticulum, Ribosome, Golgi bodies

History, structure, functions and importance

##### **Unit 5:** Lysosome, centriole, microtubules

History, structure, functions and importance

##### **Unit 6:** Nucleus

History, structure, functions and importance

##### **Unit 7:** Chromosomes

History, types and functions of chromosomes. Giant chromosomes, Polytene chromosome and Lampbrush chromosome.

##### **Unit 8:** Cell division

Mitosis (cell cycle stages, cytokinesis) Meiosis (reproductive cycle stages, synaptonemal complex, recombination nodules). Comparison between meiosis and mitosis.

#### **Block II: Molecular Biology**

##### **Unit 9:** Structure and type of DNA

Structure, functions and type of DNA, Watson and Crick's structural model of DNA, chemical composition of DNA, replication of DNA and recombinant DNA.

**Unit 10: Structure of RNA**

Structure of RNA (primary, secondary and tertiary structure) and types of RNA (transfer RNA, messenger RNA, ribosomal RNA). Biosynthesis of m- RNA, t-RNA. Function and importance of RNA.

**Unit 11: Protein Synthesis and regulation**

Protein Synthesis, mechanism (initiation, elongation and termination) of protein synthesis. Gene regulation (Operon hypothesis: regulator gene, promoter gene, operator gene, structural gene, repressor gene, co-repressor gene and inducer gene), regulation at transcription, regulation by gene arrangement and reversible phosphorylation, types of control mechanisms, regulation of gene activity in eukaryotes.

**Unit 12: Genetic Code**

Properties of genetic code, codons and anti codon, The Wobble Hypothesis, Mutation and the triplet code.

**Suggested Readings:**

1. Lewis. C.D. and Lewin, R.: Biology of Gene, Me Graw Hill, Toppan Co. Ltd.
2. Gunther S. Stent: Molecular Genetics, Macmillan Publishing Co. Inc.
3. Goodenough, V.: Genetics, New Youk Holt, Rinchart and Winston.
4. Gardner: Principles of Genetics, Wiley Eastern Pvt. Ltd.
5. Winchester Genetics, Oxford IBH Publications.
6. Stickberger Genetics, Macmillan Publications.
7. Pai, A.C.: Foundations of Genetics, Mc Graw Hill Publications.
8. Gupta, P.K.: Cytology, Genetics & Evolution, Rastogi Publications.
9. Verma. P.S. and Agarwal, V.K.: Genetics, S. Chand & Co. Ltd.