

**DISCIPLINE SPECIFIC CORE COURSE -14 –:**  
**Cell and Molecular Biology**  
**Zoo-DSC-14**

**CREDIT DISTRIBUTION, ELIGIBILITY AND PRE-REQUISITES OF THE COURSE**

Course title & Code	Credits	Credit distribution of the course			Eligibility criteria	Pre-requisite of the course (if any)
		Lecture	Tutorial	Practical		
Cell and Molecular Biology Zoo-DSC-14	04	02	Nil	02	Passed Class XII with Biology/ Biotechnology	Basic knowledge of cell biology

### Learning Objectives

The learning objectives of this course are as follows:

- to provide an understanding of structure-function relationships of nucleic acids and protein and the regulatory processes.
- to demonstrate practical knowledge of raising, handling, maintenance and special features such as antibiotic resistance of a simple prokaryotic model organism, *Escherichia coli*.
- to empower the students with a broad range of research and development related to cell signalling, cell culture and cell lines.
- to elucidate the molecular machinery and mechanism of information transfer processes- transcription and translation-in prokaryotes and eukaryotes;

### Learning Outcomes

By studying this course, students will be able to

- have a better understanding of the diverse cellular processes and cellular interactions.
- have an in-depth knowledge of the defects in cellular functioning and the molecular mechanisms that can lead to various diseases.
- appreciate the importance of homeostasis of the body and the adversities of disturbing it.
- acquire the basic information of cell signalling pathways and to elucidate its roles in gene expression and its regulation in eukaryotes.
- interpret the differences between cellular deaths; stem cells and their applications in therapeutic cloning and regenerative medicine.
- explain post-transcriptional modification mechanisms for the processing of eukaryotic mRNA.
- impart experimental skills used in clinical and research laboratories giving the students an extra edge for taking up higher studies.

## Syllabus of DSC-14

### UNIT- 1: Cell Signalling

3 hrs

Introduction to cell signalling pathways GPCR, cAMP, PKA, CREB, target gene and a nuclear receptor pathway.

### UNIT-2: Cell Death and Cell Renewal

4 hrs

Apoptosis vs. necrosis; intrinsic and extrinsic pathways of programmed cell death; stem cells and maintenance of adult tissues; embryonic and induced pluripotent stem cells.

### UNIT-3: DNA and its Replication

7 hrs

DNA replication in prokaryotes and eukaryotes-replication machinery and mechanisms, semi-conservative, bidirectional and semi-discontinuous replication, Replication of circular and linear double stranded DNA, Replication of telomeres.

### UNIT 4: Transcription

5 hrs

Machinery and mechanism of transcription in prokaryotes and eukaryotes-RNA polymerases, Transcription unit, Transcription factors, Synthesis of rRNA.

### UNIT 5: Translation

5 hrs

Genetic code, Process of protein synthesis in prokaryotes: fidelity of protein synthesis, aminoacyl-tRNA synthetases and charging of tRNA; Proteins involved in initiation, elongation and termination of polypeptide chain; Difference between prokaryotic and eukaryotic translation.

### UNIT 6: Post Transcriptional Modifications

2 hrs

Split genes: concept of introns and exons, splicing mechanism, alternative splicing, and RNA editing.

### UNIT 7: Gene Regulation

4 hrs

Transcription regulation in prokaryotes: Lac operon; Overview of transcription regulation in eukaryotes: Activators, repressors, enhancers, silencer elements.

### Practical

(60 hrs)

(Laboratory periods: 15 classes of 4 hours each)

1. Requirement of a Tissue culture laboratory, its equipment and its layout. Concept of cell culture and cell lines; Media preparation for mammalian tissue culture.
2. Preparation of permanent slides of mitosis/meiosis\*.
3. Study of Polytene chromosomes from *Chironomous/Drosophila* larva.
4. Inoculation and culture of *E. coli* in liquid culture medium (LB).
5. Preparation of solid culture medium (LB) and growth of *E. coli* by spreading and streaking.
6. Estimation of the growth kinetics of *E. coli* from the data provided.
7. Quantitative estimation of salmon sperm/calf thymus DNA using colorimeter.

(Diphenylamine reagent) or spectrophotometer ( $A_{260}$  measurement).

8. Study and interpretation of electron micrographs/photographs showing: DNA replication, Transcription, and Split genes.
9. Project related to topics covered in theory/ project report based on visit to labs/institutions/industry etc.

\*Subject to UGC guidelines

### **Essential/recommended readings**

1. Karp, G. (2010) Cell and Molecular Biology: Concepts and Experiments. VI Edition. John Wiley and Sons. Inc.
2. R. Ian Freshney (2021) Freshney's Culture of Animal Cells: A Manual of Basic Technique and Specialized Applications; Wiley-Blackwell.
3. Lodish et. al., (2007), Molecular Cell Biology, W.H. Freeman and Company, New York, USA
4. Alberts et. al., (2008), Molecular Biology of the Cell Garland Science, Taylor & Francis Group, New York, USA.
5. Cooper G. M. and Robert E. Hausman R. E. The Cell: A Molecular Approach, V Edition, ASM Press and Sinauer Associates.
6. Becker, W.M., Kleinsmith, L.J., Hardin. J. and Bertoni, G. P. (2009). The World of the Cell. VII Edition. Pearson Benjamin Cummings Publishing, San Francisco.

### **Suggestive readings**

1. Watson, J. D. Baker T.A. Bell, S. P. Gann, A. Levine, M. and Losick, R. (2008) Molecular Biology of the Gene. VI edition. Cold Spring Harbour Lab. Press, Pearson Pub.
2. Lewin B. (2008). Gene XI. Jones and Bartlett.
3. Gupta, R., Makhija, S. and Toteja, R. (2018). Cell Biology Practical Manual, Prestige Publishers, New Delhi-110003.
4. Sharma, V. K. (1991). Techniques in Microscopy and Cell Biology, Tata McGraw Hill Publishing Company Limited, New Delhi.

**NOTE: Examination scheme and mode shall be as prescribed by the Examination Branch, University of Delhi, from time to time.**