

**ADVANCED CELL BIOLOGY AND IMMUNOTECHNOLOGY  
(BIOT 5231)**

**Time Allotted : 3 hrs**

**Full Marks : 70**

*Figures out of the right margin indicate full marks.*

*Candidates are required to answer Group A and  
any 5 (five) from Group B to E, taking at least one from each group.*

*Candidates are required to give answer in their own words as far as practicable.*

**Group - A  
(Multiple Choice Type Questions)**

1. Choose the correct alternative for the following: **10 × 1 = 10**
- (i) Which of the following substances is transported through a carrier mediated protein?  
(a) Na<sup>+</sup>                      (b) Ca<sup>2+</sup>                      (c) Oxygen                      (d) Glucose.
- (ii) The enzyme responsible for synthesis of cAMP is  
(a) Adenylate cyclise                      (b) Adenylate hydroxylase  
(c) Adenylyl methyl transferase                      (d) cAMP synthatase.
- (iii) Which of the following molecules does not react with a cell membrane receptor?  
(a) Insulin                      (b) Glucagon  
(c) EGF                      (d) Testosterone.
- (iv) Rhodopsin is a protein associated with  
(a) olfactory signal transduction  
(b) signal transduction through cytokines  
(c) visual signal transduction  
(d) signal transduction induced by heat.
- (v) In order to enter the cell cycle a cell must be stimulated from outside. What type of molecule provides this stimulation?  
(a) Cyclins                      (b) Cyclin-dependent kinases  
(c) Cytokines and growth factors                      (d) Tyorise kinases.
- (vi) The cell cycle of a germinal cell has  
(a) two successive mitotic divisions  
(b) two successive reduction divisions  
(c) very short prophase in first division  
(d) one reduction division followed by one mitotic division.

- (vii) What is responsible for the equal distribution of replicated chromosomes into each of two daughter cells?  
(a) Mitotic spindle (b) Random motion  
(c) Centromeres (d) Chromatids.
- (viii) In hybridoma technology, which of the following cells are made deficient of HGPRT enzyme?  
(a) B cells (b) Hybrid cells  
(c) Myeloma cells (d) None of these.
- (ix) Which of the following cell organelle actively participates in animal apoptosis?  
(a) Vacuoles (b) Chloroplast  
(c) Nucleus (d) Mitochondria.
- (x) Hybridoma technology was developed by  
(a) Kohler and Milstein (b) Beadle and Tatum  
(c) Khorana and Nirnberg (d) Khorana and Kornberg.

### Group- B

2. (a) Alpha helix and beta-barrel are the two major structures found in transmembrane proteins. Give the reason behind this.  
[[CO1](Reasoning/HOCQ)]
- (b) What is glycocalyx? Why is it important to the cell?  
[[CO1](Understand, Reasoning/IOCQ, HOCQ)]
- (c) Draw a schematic diagram of a calcium channel and describe its structure in brief.  
[[CO1](Remember/LOCQ)]  
**4 + (2 + 2) + 4 = 12**
3. (a) What are SNAREs? Discuss the role of SNAREs in induced exocytosis.  
[[CO1](Remember, Describe/LOCQ, IOCQ)]
- (b) Proteolytic enzymes undergo processing in the secretory vesicles instead of in the ER lumen. Discuss the advantage of this delayed cleavage of the proteolytic enzymes.  
[[CO1](Describe/IOCQ)]
- (c) Describe the role of COPII for transport of proteins from ER.  
[[CO1](Describe/IOCQ)]  
**(2 + 4) + 2 + 4 = 12**

### Group - C

4. (a) State the functions of three different microtubules in maintaining the shape and structure of a cell.  
[[CO2](Remember/LOCQ)]
- (b) Why second messengers are called 'second' messengers in the signal transduction process?  
[[CO2](Understand/IOCQ)]
- (c) Discuss the generation of IP3 and DAG during the signal transduction process.  
[[CO2](Describe/IOCQ)]  
**6 + 3 + 3 = 12**

5. (a) What is an SH2 domain? What is the importance of this domain in signal transduction process? [(CO2)(Remember/LOCQ)]  
(b) Describe the signal transduction process by JAK-STAT pathway. [(CO2)(Describe/IOCQ)]  
(c) How does the JAK-STAT pathway differ from the MAPK pathway? [(CO2)(Differentiate/HOCQ)]  
**(1 + 2) + 6 + 3 = 12**

### Group - D

6. (a) Explain how apoptosis plays an important role in regular physiological functions in mammalian cells. [(CO3)(Remember/LOCQ)]  
(b) What are caspases? Describe the TNF receptor signaling in caspase activation. [(CO3)(Describe/LOCQ)]  
(c) How does chromatin breakdown occur during apoptosis? [(CO4)(Describe/IOCQ)]  
**4 + 4 + 4 = 12**
7. (a) Describe briefly the structure of plant cell wall. [(CO4)(Remember/LOCQ)]  
(b) Analyze how tight junctions mediate cell-cell interactions. [(CO4)(Analyze/IOCQ)]  
(c) Discuss the structure and function of gap junctions. [(CO4)(Understand/LOCQ)]  
**4 + 4 + 4 = 12**

### Group - E

8. (a) An ELISA designed to test for the presence of serum antibody for a new strain of pathogenic bacteria is under development. Initially, a monoclonal antibody specific for a single epitope of the organism was used both to sensitize the wells of the ELISA plate and as the enzyme-labeled detecting antibody in a conventional sandwich ELISA. The ELISA failed to detect the antigen despite the use of a wide range of antibody concentrations. What is the most probable cause of this problem? [(CO4)(Justify/HOCQ)]  
(b) How do you produce humanized antibodies? [(CO4)(Analyze/IOCQ)]  
(c) Discuss the role of conjugated peptide vaccines in disease diagnosis and therapeutics. [(CO5)(Describe/LOCQ)]  
**4 + 4 + 4 = 12**
9. (a) Discuss the recent trends in the domain of antibody engineering. [(CO5)(Describe/IOCQ)]  
(b) What are the advantages of synthetic vaccines? [(CO5)(Understand/LOCQ)]  
(c) Design an experiment to develop a vaccine against a cancerous cell using the immunotherapy approach. [(CO5)(Design/HOCQ)]  
**4 + 4 + 4 = 12**

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	44.79	35.42	19.79

**Course Outcome (CO):**

After completing this course, students should be able to

1. Understand the mechanisms of cellular transport & trafficking.
2. Analyze the different channels of cell signaling and their interaction with different molecules.
3. Describe the mechanism of cell cycle and its components.
4. Analyze the mechanism of programmed cell death and its applications in human therapeutics.
5. Apply the knowledge of different bioassays and vaccinology in disease diagnosis and human healthcare.

\*LOCQ: Lower Order Cognitive Question; IOCQ: Intermediate Order Cognitive Question; HOCQ: Higher Order Cognitive Question