ADVANCED CELL BIOLOGY AND IMMUNOTECHNOLOGY
(BIOT 5231)

Time Allotted : 2½ hrs **Full Marks : 60**

Figures out of the right margin indicate full marks.

Candidates are required to answer Group A and any 4 (four) from Group B to E, taking one from each group.

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

Group – A

1. Answer any twelve: **12 × 1 = 12**

Choose the correct alternative for the following

(i) Action potential is generated by
(a) Opening of voltage gated Na^+ channels
(b) Closing of voltage gated Na^+ channels
(c) Opening of ligand gated Na^+ channels
(d) Opening of ligand gated K^+ channels

(ii) In neurotransmission, excess Na^+ comes in and K^+ moves out of the cell. How the homeostasis is recovered?
(a) By activation of Ca^{+2} channels (b) By opening of K^+ channels
(c) By activation of Na^+K^+ pump (d) By dissociation of phospholipids

(iii) Protein kinase C is activated by
(a) Calcium (b) Cyclic AMP
(c) Both Calcium and DAG (d) Hemoglobin

(iv) JaK-STAT pathway of signal transduction is involved in
(a) Signal transduction through second messengers
(b) Signal transduction through receptor kinases
(c) Signal transduction through direct entry of the molecules
(d) Transport of macromolecules

(v) How does a somatic cell that has just completed the S phase of its cell cycle compare in respect to its number of chromosomes and amount of DNA with a gamete of the same species?
(a) It has twice the number of chromosomes and twice the amount of DNA
(b) It has the same number of chromosomes but twice the amount of DNA
(c) It has the twice the number of chromosomes and four times the amount of DNA
(d) It has the four times the number of chromosomes and twice the amount of DNA.

(vi) Which of the following cell organelle actively participates in animal apoptosis?
(a) Vacoules (b) Chloroplast
(c) Nucleus (d) Mitochondria.

(vii) Caspases belong to the class of _____.
(a) Serine proteases (b) Cystine proteases
(c) Aspertate proteases (d) Hydrolases

(viii) Which of the following groups of proteins associate with kinases and are synthesized and degraded at specific points during the cell cycle?
(a) Cyclins (b) Growth factors
(c) Ccyclin dependent kinases (d) Survival factors.

(ix) Which of the following statement is incorrect about HAT medium?
(a) HAT medium is a selective medium.
(b) Aminopterin in the HAT medium blocks *de novo* pathway.
(c) Salvage pathway requires aminopterin and thymidine.
(d) Hypoxanthine is converted to Guanine by HGPRT enzyme.

(x) Which immune cells are generally used in the treatment of cancer using adoptive immunotherapy?
(a) Mast cells (b) Dendritic cells
(c) Neuronal cells (d) Malignant cells.

Fill in the blanks with the correct word

(xi) FG repeat is present in _____.

(xii) Glycosylation of proteins occurs in _____ .

(xiii) _____ is an example of symport.

(xiv) cGMP acts as a _____ in signal transduction process.

(xv) Duplication of Centrosomes takes place in ____ phase of cell cycle.

Group - B

2. (a) How the transport through carrier proteins and channels can be differentiated by their kinetics? *[(CO1)(Differentiate/IOCQ)]*
(b) Describe glucose transport along with sodium ions across the membrane. *[(CO1)(Describe/LOCQ)]*
(c) Describe the role of voltage gated ion channels in transmission of neuronal impulse along the axon. *[(CO1)(Describe/LOCQ)]*
3 + 3 + 6 = 12

3. (a) Why lysosomal enzymes are active in lysosomes and not in the cytosol? *[(CO1)(Remember/LOCQ)]*
(b) What are the different pathways for delivering the degradation materials to lysosomes? *[(CO1)(Understand/IOCQ)]*
(c) How high-mannose proteins are transported to lysosomes? *[(CO2)(Understand/ IOCQ)]*
2 + 6 + 4 = 12

Group - C

4. (a) Discuss the role of Ras protein in signal transduction process. *[(CO2)(Understand/LOCQ)]*

   (b) G-protein is not a receptor for an external ligand. It is not second messenger either. In spite of that it plays a significant role in signal transduction. Comment on this statement. *[(CO2)(Comment/IOCQ)]*

   (c) What is an SH2 domain? State its role in signal transduction process. *[(CO2)(Comment/IOCQ)]*

4 + 4 + (2 + 2) = 12

5. (a) Dimerisation of the receptors is an important step for signal transduction through Receptor Tyrosine Kinases (RTKs). State and demonstrate with figures how the receptors of PDGF, EGF and FDGF dimerise upon binding with their respective ligands. *[(CO2)(Demonstrate/HOCQ)]*

   (b) How does autophosphorylation of Tyrosine residues activate the rest of the signal transduction process? *[(CO2)(Understand/IOCQ)]*

   (c) What is MAP kinase? Write the full form. *[(CO2)(Remember/LOCQ)]*

6 + 4 + 2 = 12

Group - D

6. (a) Give a sequential account of the cellular G1-M transition by Cdk and Cyclins. *[(CO3)(Remember/LOCQ)]*

   (b) Helper T-cells are the main targets during HIV infection. Justify the statement in connection to cell suicide. *[(CO3,4)(Justify/HOCQ)]*

   (c) Discuss some of the examples of apoptosis events that occur in adult cells. *[(CO3,4)(Describe/LOCQ)]*

4 + 4 + 4 = 12

7. (a) Analyze the role of plant cell walls in preventing cell swelling. *[(CO4)(Analyze/IOCQ)]*

   (b) Give a comparative account between adherens junctions and desmosomes. *[(CO4)(Compare/IOCQ)]*

   (c) Comment on the structure and function of Gap Junctions. *[(CO4)(Remember/LOCQ)]*

4 + 4 + 4 = 12

Group - E

8. (a) Discuss any one example of antibody engineering for targeted immunotherapy.. *[(CO5)(Remember/LOCQ)]*

   (b) Analyze the role of monoclonal antibodies in disease diagnosis and therapeutics. *[(CO5)(Analyze/IOCQ)]*

   (c) 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? Justify with reason. *[(CO5)(Criticize/IOCQ)]*

4 + 4 + 4 = 12

9. (a) Design an experiment to prepare a cancer vaccine using immunotherapy. *[(CO5)(Design/HOCQ)]*

(b) Describe the methodology to prepare a conjugated peptide vaccine. *[(CO5)(Describe/LOCQ)]*

(c) Mention the advantages of using a synthetic vaccine for immunization. *[(CO5)(Compare/IOCQ)]*

4 + 4 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	38.54	46.88	14.58

Course Outcome (CO):

After the completion of the course students will be able to
1. Understand the mechanisms of cellular transport and trafficking
2. Analyze the different channels of cell signalling and their interaction with different molecules.
3. Describe the mechanism of cell cycle and its component.
4. Analyze the mechanism of programmed cell death and its application 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.*