

**ANIMAL CELL CULTURE & ANIMAL BIOTECHNOLOGY
(BTC3221)**

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) Laminin is used as a substrate coating because it interacts with ____ on the animal cell surface
 - (a) Ornithine
 - (b) Poly-D-lysine
 - (c) Integrin
 - (d) Concanavalin
- (ii) Which of the following is not present in growth medium for animal cell culture?
 - (a) Inorganic salts
 - (b) Bicarbonate
 - (c) Carbon source
 - (d) Starch
- (iii) Disaggregating of cells can be performed by:
 - (a) Physical disruption
 - (b) Enzymatic digestion
 - (c) Treating with chelating agents
 - (d) All of the above
- (iv) At small substrate concentration Monod model behaves as reaction of the type.
 - (a) first order
 - (b) pseudo first order
 - (c) second order
 - (d) zero order 4
- (v) Perfusion system is used for the production of
 - (a) antibiotics
 - (b) alcohol
 - (c) monoclonal antibody
 - (d) single cell protein
- (vi) Which of the following is the most critical parameter to monitor and control in a large-scale animal cell culture bioreactor to mitigate the risk of cell damage and lysis?
 - (a) Nutrient concentration
 - (b) Dissolved oxygen level
 - (c) Shear stress
 - (d) pH level.
- (vii) The technique used in Animal biotechnology for the rapid multiplication and production of animals with a desirable genotype is
 - (a) protoplast fusion and embryo transfer
 - (b) hybrid selection and embryo transfer
 - (c) invitro fertilization and embryo transfer
 - (d) All the above.

- (viii) Which one of the following techniques is generally used to produce transgenic animals?
- Processed mRNA containing only exons are introduced into blastocyst stage embryo.
 - Entire foreign nucleus is introduced in enucleated unfertilized egg.
 - Desired DNA is injected into fertilized eggs followed by implantation of embryo in foster embryo in a foster mother.
 - cDNA of desired gene is introduced into animal embryos and implanted in a foster mother these
- (ix) Which of the following cannot be used to produce corona virus vaccine
- Animal cell-based vaccine
 - Egg-based vaccine
 - Recombinant vaccine
 - Genetically mutated
- (x) DNA vaccine offer several advantages over other existing vaccine approaches. Which one of the following statements related to DNA vaccine is not correct?
- The immune response is directed to the antigen encoded by the DNA and able to induce both humoral and cell mediate immunity.
 - DNA vaccine can induce prolonged expression of the antigen, enhancing the induction of immunological memory.
 - DNA vaccine could remain stable and potent for long time without refrigeration, eliminating the challenges of storage and transportation.
 - DNA vaccine construct can be engineered to carry several antigens to infect host and replicate in neuronal cells.

Fill in the blanks with the correct word

- (xi) In Monod Chemostat Model, $D_{\max}$, the dilution rate for maximum cell output can be evaluated by _____.
- (xii) The substrate concentration at which the specific growth rate (μ) is half of the maximum specific growth rate ($\mu_{\max}$) is called _____.
- (xiii) TALEN is _____ tool.
- (xiv) The principal of staining of animal cell with Trypan blue by dye _____ method.
- (xv) Serum supplies _____ in animal cell culture media.

Group - B

2. (a) Draw and write names three type of animal culture vessels for the following types of animal cell cultivation systems: (i) Static cultivation system, (ii) Semi-dynamic cultivation system, (iii) Dynamic cultivation system. [[C01](Remember/LOCQ)]
- (b) (i) Explain the principle of flowcytometry and different parts of flowcytometer with a diagram. (ii) Explain the application of flowcytometry to analyse human blood cells based on their size, with standard experimental result. [[C02](Explain/IOCQ)]
- (c) What are the names of three types of Mammalian cells based on their morphology? Describe the special features of each of the types of mammalian cells with example. [[C02](Apply/IOCQ)]

$$3 + (3 + 3) + 3 = 12$$

3. (a) Explain, how the contamination by mycoplasma can be detected in animal cell culture. [[CO1](Analyse/HOCQ)]
- (b) Write the names of three different types of methods of identification of specific animal cell lines. Describe principle of any one method in details with labelled diagram. [[CO2](Remember/LOCQ)]
- (c) Write the names of different serum components and their role in animal cell culture. Why heat inactivation of serum is done before using in the media? Why more than one freeze-thaw cycle after heat-inactivation is not recommended? [[CO2](Apply/IOCQ)]
- 3 + (1 + 3) + (3 + 1 + 1) = 12**

Group - C

4. The growth of animal cell culture is carried out in a steady state chemostat with substrate concentration ($S_0 = 10 \text{ kg/m}^3$) and an inhibitor concentration ($I = 0.05 \text{ kg/m}^3$). The inhibition kinetics are given below.
 $\mu = [\mu_{\max} S] / [S + K_s (1 + I/K_i)]$, The following kinetic parameters are available $X_0 = 0$, $\mu_{\max} = 0.5 \text{ hr}^{-1}$, $K_s = 1 \text{ kg/m}^3$, $K_i = 0.01 \text{ Kg / m}^3$, $Y_{x/s} = 0.75 \text{ Kg/Kg}$.
 (i) Show the graphical plot X and S vs D.
 (ii) Show the same plot when $I = 0$. [[CO4](Evaluate/HOCQ)]
- (6 + 6) = 12**
5. (a) From Monod model determine the linear relationship between μ and $[s]$, and calculate the dimension of constant of the linear equation. [[CO4](Analyse/IOCQ)]
- (b) Explain the physical significance of the first order rate constant. [[CO4](Remember/LOCQ)]
- (c) Define Chemostat operation. [[CO4](Understand/IOCQ)]
- (4 + 2) + 3 + 3 = 12**

Group - D

6. (a) Explain and write the steps of creation of KO mouse using ES cells and through classical HR method with diagram. [[CO5](Explain/HOCQ)]
- (b) Explain in details how ES cell carrying KO gene was selected by positive and negative selection. [[CO5](Remember/IOCQ)]
- (c) Explain and write the steps of creation of KO mouse using cre-loxP method with diagram. [[CO5](Apply/IOCQ)]
- 4 + 4 + 4 = 12**
7. (a) Describe the steps of IVF with label diagram. [[CO5](Analyse/HOCQ)]
- (b) What is chimera? Explain gene targeting and gene trapping? [[CO5](Remember/LOCQ)]
- (c) Explain the mechanism of control gene expression in animal expression vector system by Tet Off and Tet On system. [[CO5](Apply/HOCQ)]
- 4 + (1 + 3) + 4 = 12**

Group - E

8. (a) Using only a labelled diagram describe the steps of ES cell collection. [[C06](Remember/LOCQ)]
- (b) Describe the approaches of stem cell therapies for neurological disease using transplantation of neural stem cells. [[C06](Remember/LOCQ)]
- (c) Explain with examples the differences between biopharmaceuticals and biosimilars. [[C06](Explain/IOCQ)]
- (d) With labelled diagrams describe the steps of Baculovirus and insect cell expression system for biomanufacturing of biopharmaceuticals. [[C06](Apply/IOCQ)]
- 3 + 3 + 2 + 4 = 12**
9. (a) A genetic disease causes due to defect in one gene-X. Now, explain and write the steps for curing from this disease to remove the defective gene, by gene therapy using CRISPR-Cas9 with a labelled diagram. [[C06](Explain/IOCQ)]
- (b) Write three differences between 3-D and 2-D cell culture. [[C06](Remember/LOCQ)]
- (c) Explain and write all the steps of animal cell culture-based vaccine (inactivated whole virus) production for an animal virus using labelled diagram. [[C06](Apply/IOCQ)]
- 5 + 3 + 4 = 12**
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Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	23.96	47.92	28.12