

agitator speed (rpm) of the large bioreactor with same impeller tip speed as that of the small bioreactor.

$$4 + 4 + 4 = 12$$

Group – D

6. (a) What is superovulation? How it is induced?
 (b) Write the name of different biopharmaceuticals produced from transgenic animals.
 (c) Describe the three major types of method of introduction of exogenous DNA into animal cells with label diagram.

$$(1 + 2) + 3 + 6 = 12$$

7. (a) What is genome editing? Write the names of four modern techniques for genome editing. Describe the most popular techniques of genome editing with diagram.
 (b) Write name of first test tube baby in India. Describe the steps involved in IVF.
 (c) "Transgenic animal are Bioreactors for large scale production of substances of human welfare and improvement of production of traits" — Justify the statement with examples.

$$(1 + 1 + 3) + (1 + 3) + 3 = 12$$

Group – E

8. (a) What is the objective of organ culture? How does it differ from organotypic culture?
 (b) What are the limitation of using adult stem cell?
 (c) What is regenerative medicine? How stem cells can be used as a source of neurons for transplantation in Parkinsonism's disease?

$$(1 + 3) + 3 + (1 + 4) = 12$$

9. (a) Write names of four biopharmaceuticals produced by animal biotechnology.
 (b) What is polyclonal antibody? Describe the techniques for the production of monoclonal antibody.
 (c) What is the difference between protein therapy and gene therapy? Give one example of the disease for each of the therapy? Describe mechanism of gene therapy using animal cell to cure cystic fibrosis.

$$2 + (1 + 3) + (1 + 1 + 4) = 12$$

ANIMAL CELL CULTURE & ANIMAL BIOTECHNOLOGY (BIOT 4101)

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) Fed batch cultivation is suitable for which of the following?
 P. Processes with substrate inhibition.
 Q. Processes with product inhibition.
 R. High cell density cultivation.
 (a) P and Q only (b) P and R only
 (c) Q and R only (d) P, Q and R.
- (ii) Range of osmolarity tolerated / accepted in mOsm/Kg of H₂O by mammalian cells is
 (a) 150-300 (b) 280-360
 (c) 300-325 (d) 360-400.
- (iii) Disaggregating of cells can be achieved by
 (a) physical disruption (b) enzymatic digestion
 (c) treating with chelating agents (d) all of the above.
- (iv) Accumulation of lactate leads to
 (a) increase in pH
 (b) no change in pH
 (c) reduction in the pH of culture hence loss of cell viability
 (d) no loss of cell viability.
- (v) Excess CO₂ suppress cell growth and productivity by
 (a) inhibiting respiration
 (b) altering intracellular pH by diffusing across cell membrane
 (c) both (a) and (b)
 (d) altering pH of the medium.

- (vi) The growth medium for mammalian cells contains serum. One of the major functions of serum is to stimulate cell growth and attachment. However, it must be filter sterilized to
- remove large proteins
 - remove collagen only
 - remove mycoplasma and microorganism
 - remove foaming agent.
- (vii) Volumetric mass transfer coefficient, $K_L a$ in a CSTR is correlated to
- P/V
 - superficial gas velocity
 - rotational speed
 - both (a) & (b).
- (viii) Match the entries in group I with the methods of sterilization in group II for animal cell culture.

Group-I

- P. Serum
Q. PBS
R. T-flask
S. Biological safety cabinet

Group-II

1. Autoclave
2. Membrane
3. UV radiation
4. Gamma radiation
5. Dry heat

Codes:

	P	Q	R	S		P	Q	R	S
(a)	5,	3,	1,	4	(b)	2,	1,	4,	3
(c)	1,	4,	5,	3	(d)	4,	1,	3,	5

- (ix) Somatic cell gene transfer is used for
- transgenic animal production
 - transgenic diploid cell production
 - in-vitro* fertilization
 - classical breeding fertilization
- P, R, and S
 - P and R
 - P, Q and R
 - P only.
- (x) During transgenesis, the location of the genes and their number integrated into genome of the transgenic animal are random. It is often necessary to determine the copy number of genes and their tissue specific transcription. The following are the possible methods used for the determination.
- Polymerase chain reaction
 - Southern blotting hybridization
 - Reverse transcriptase PCR
 - Western blotting
- Choose the correct set of combination
- P and Q
 - Q and S
 - Q and R
 - P and S.

Group – B

2. (a) What are the different types of methods used for disaggregation of animal tissue or organ fragment? What are different enzymes used for disaggregation of animal tissue or organ fragment?
- (b) Describe briefly the procedure involved in warm and cold trypsinisation for the preparation of primary culture from animal tissue or organ fragment.
- (c) Write three important advantages of cold trypsinization.
(2 + 2) + 6 + 2 = 12
3. (a) 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.
- (b) Write the names of three different types of techniques of transformation of animal cells. Describe principle of any one techniques of transformation of animal cells with labelled diagram.
- (c) Write the characteristics which are used for animal cell separation by physical methods. Describe one technique of animal cell separation which is based on light scattering and fluorescence.
(1 + 3) + (1 + 3) + (1 + 3) = 12

Group – C

4. (a) How do you maintain air humidity in CO₂ incubator?
- (b) Derive Monod Chemostat model for steady state CSTR and find wash-out condition. Show the entire result graphically.
3 + (3 + 3 + 3) = 12
5. (a) In a fed-batch culture, 200 g. L⁻¹ glucose solution is added at a flow rate of 50 L.h⁻¹. The initial culture volume (at quasi steady state) and the initial cell concentration are 600 L and 20 g.L⁻¹ respectively. The yield coefficient ($Y_{x/s}$) is 0.5 g cell mass. g substrate⁻¹. Calculate the cell concentration (g. L⁻¹) at quasi steady state at t = 8 h.
- (b) A T-flask is seeded with 10⁵ anchorage dependent cells. The available area of the T-flask is 25 cm² and the volume of the medium is 25 ml. Assume that the cells are rectangles of size 5 μm × 2 μm. The cells grow to monolayer confluence, the calculate the growth rate in number of cells / (cm².h) after 50 h.
- (c) A batch bioreactor is to be scaled up from 10 to 10,000 liters. The diameter of the large bioreactor is 10 times that of the small bioreactor. The agitator speed in the small bioreactor is 450 rpm. Determine the