

**TISSUE ENGINEERING
(BIOT 4242)**

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) The epidermis is considered the outermost component of the skin and primarily comprised of _____ a specific type of epithelial cells.
(a) keratinocytes (b) collagen
(c) stem cells (d) chondrocytes
 - (ii) Embryonic stem cells are derived from the _____ of the blastocyst.
(a) inner cell mass (b) ectoderm
(c) blastocoels (d) mesoderm
 - (iii) Which of the following is a major focus of a technique of tissue engineering called autologous chondrocyte transplantation (ACT)?
(a) Cartilage (b) Bone (c) Skin (d) Stem Cells.
 - (iv) _____ produce the myelin sheath insulating neuronal axons.
(a) Oligodendrocytes (b) Osteocytes
(c) Myocytes (d) Cardiomyocytes.
 - (v) How many transmembrane alpha-helices are present in the G-protein coupled receptors?
(a) Two (b) Four (c) Five (d) Seven.
 - (vi) Which of the following is a cell surface receptor?
(a) Enzyme-linked receptors (b) G protein-linked receptors
(c) Ion-channel linked receptors (d) All of the above.
 - (vii) Bioreactor culture improves the nutrient supply by
(a) decreasing the diffusion distance
(b) decreasing the convection
(c) decreasing the mass transfer
(d) decreasing the convection and mass transfer.

- (viii) Which is possible contribution of computational fluid dynamic modelling to the development of a bioreactor system?
(a) Prediction of patterns of shear stress
(b) Prediction of local profiles of oxygen consumption
(c) Prediction of efficiency of glucose utilization.
(d) Both (a) and (c).
- (ix) Which of the following are potential therapeutic uses of embryonic stem cells?
(a) Repair damage to heart muscle after a heart attack
(b) Regenerate cells of the immune system
(c) Replace neurons after an accident
(d) All of the above are potential therapeutic uses of embryonic stem cells.
- (x) Bleeding, inflammation, proliferation, remodelling are phases of
(a) wound healing (b) clotting
(c) cell differentiation (d) cell maturation.

Group- B

2. (a) Elucidate the importance of Neural Crest cells in the Gastrulation process.
[[CO1](Understand /LOCQ)]
(b) Analyze with reasons why Embryonic Stem cells are important for tissue engineering.
[[CO1](Analyze/IOCQ)]
(c) Comment on the haemodynamics of blood vessel wall formation during embryogenesis.
[[CO1](Analyze/IOCQ)]
4 + 4 + 4 = 12
3. (a) Give a brief overview of the central paradigm of cellular signalling.
[[CO2](Remember/LOCQ)]
(b) Analyze how integrins can perform both inside-out and outside-in signal initiation.
[[CO2](Analyze/IOCQ)]
(c) Comment on the importance of integrins in tissue engineering.
[[CO2](Understand/LOCQ)]
4 + 4 + 4 = 12

Group - C

4. (a) What are the advantages of porogen leaching technique for scaffold fabrication? How self-assembly of molecule can be used for scaffold fabrication?
[[CO3](Remember/LOCQ)]
(b) Describe the role of alginate in wound healing and cartilage repair? How can we promote cell adhesion property on scaffolds?
[[CO3](Remember/IOCQ)]
(c) What is Rapid Prototyping? What are the advantages of Rapid Prototyping technique over the other scaffold fabrication techniques?
[[CO3](Analyse/HOCQ)]
(2 + 2) + (2 + 2) + (1 + 3) = 12

5. (a) How cellulose can be applied in vascular tissue engineering? What is the most important disadvantage of cellulose and how it can be controlled?
 [(CO3)(Understand/LOCQ)]
 (b) What are the different motifs that play an important role in cell-ECM interaction?
 [(CO4)(Understand/IOCQ)]
(6 + 2) + 4 = 12

Group - D

6. (a) Derive and explain the Monod model for mammalian cell growth.
 [(CO5)(Explain/HOCQ)]
 (b) Write the difference between the following:
 (i) ESC and ASC.
 (ii) Growth factor receptor and integrin.
 [(CO4)(Analyse/IOCQ)]
(3 + 3) + (3 + 3) = 12
7. (a) Mention the names of three different techniques for the preservation of cell or tissue. Describe any one of the techniques.
 [(CO4)(Understand/LOCQ)]
 (b) What are the different types of stem cells present according to their source?
 [(CO4)(Understand/LOCQ)]
 (c) What is 3-D culture? How does 3-D culture help in TE?
 [(CO5)(Apply/HOCQ)]
(1 + 3) + 4 + (1 + 3) = 12

Group - E

8. (a) Give an outline of different approaches of using tissue engineering scaffolds for immunomodulation.
 [(CO5)(Remember/LOCQ)]
 (b) Discuss the mechanism of controlled release of bioactive molecules of interest in tissue engineering.
 [(CO6)(Understand/LOCQ)]
 (c) Justify with reasons the ethical issues involved in usage of stem cells in tissue engineering.
 [(CO6)(Justify/HOCQ)]
4 + 4 + 4 = 12
9. (a) Describe the cellular process of bone repair after a fracture.
 [(CO5)(Remember/LOCQ)]
 (b) Give a brief outline of different regenerative therapeutic approaches of optic nerve.
 [(CO6)(Analyze/IOCQ)]
 (c) Nowadays, hydrogel matrices are being used for entrapment of drug molecules. Justify the statement with suitable examples.
 [(CO6)(Justify/HOCQ)][(CO5)(Criticize/HOCQ)]
4 + 4 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	46	31	23

Course Outcome (CO):

At the end of this course students will be able to:

1. Explain the significance, current status and future potential of tissue engineering, identify requirements of tissue engineering, comprehend the structural organization of cells and tissues, the role of cell interaction, cell migration, wound healing and cellular processes.
2. Identify key challenges in tissue engineering of different human tissues; understand the importance of cell signaling, angiogenesis in tissue engineering.
3. Understand the design, fabrication and biomaterials selection criteria for tissue engineering scaffolds.
4. Understand the sources, selection, potential manipulations, storage and challenges of using stem cells for tissue engineering.
5. Use simple models to quantify aspects of bioreactor design in the context of tissue engineering, understand the basics of 3D cell culture.
6. Discuss the challenges of in vivo implantation of biomaterials and scale-up issues relating to human clinical applications and explain the ethical and regulatory issues of significance in tissue engineering.

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