

TISSUE ENGINEERING
(BIOT 4242)

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) _____ are the most widely used stem cell source for articular cartilage regeneration technique.
 - (a) Mesenchymal Stem Cells
 - (b) Induced Pluripotent cells
 - (c) Adult stem cells
 - (d) Inner cell mass
- (ii) The extracellular matrix (ECM) in tissue engineering is important for which reason?
 - (a) Providing structural and biochemical support to cells
 - (b) Acting as the primary energy source for cells
 - (c) Serving as a barrier to prevent cell movement
 - (d) Functioning as a primary source of nutrients
- (iii) What is the most abundant component of the ECM by dry weight
 - (a) Collagen,
 - (b) Fibronectin,
 - (c) Glycosaminoglycan,
 - (d) laminin.
- (iv) Polymeric biomaterial is generally sterilized by
 - (a) dry heat sterilization
 - (b) moist heat sterilization
 - (c) gas sterilization
 - (d) gamma sterilization.
- (v) A culture vessel in which physical, physicochemical and physiological conditions, as well as cell concentration, are kept constant is known as _____.
 - (a) Cell concentrator
 - (b) Batch bioreactor
 - (c) Biostat
 - (d) Incubator
- (vi) Which one of the following can't be a limiting substrate if Monod's growth kinetics is applicable?
 - (a) Extracellular carbon source
 - (b) Extracellular nitrogen source
 - (c) Intracellular carbon source
 - (d) Dissolved oxygen

- (vii) What is the fundamental purpose of using a bioreactor in tissue engineering?
 (a) To solely maintain a sterile environment for cell culture.
 (b) To provide mechanical stimulation and controlled physicochemical conditions for tissue development in vitro.
 (c) To exclusively automate the seeding of cells onto a scaffold.
 (d) To serve as a high-throughput drug screening platform.
- (viii) _____ are the favourite cell type in tissue engineering as they don't evoke an immune response.
 (a) Autologous cells (b) Heterogeneous cells
 (c) Differentiated stem cells (d) Fibroblasts
- (ix) The process by which extracellular messages translate into intracellular changes is termed _____.
 (a) cell signalling (b) cell adhesion
 (c) signal transduction (d) cell transformation
- (x) _____ are simply osteoblasts trapped in the matrix that they secrete.
 (a) Osteocytes (b) Hepatocytes
 (c) Thrombocytes (d) Chondrocytes

Fill in the blanks with the correct word

- (xi) _____ is a protein that helps in maintaining the structural integrity of most of the connective tissues in animals.
- (xii) _____ polymers as biomaterials is generally known for its ability to degrade naturally over time within the body, allowing the native tissue to gradually take over the mechanical load.
- (xiii) _____ acid plays an important role in wound healing.
- (xiv) _____ is a method of forming blood vessels within constructs before the latter are implanted in the defect sites.
- (xv) Most common type of bioreactor used in tissue engineering is _____.

Group - B

2. (a) Discuss the role of integrins in cell signalling pathways. [[CO2](Analyse/IOCQ)]
 (b) Illustrate the molecular events of the signal transduction process in cell signalling. [[CO2](Remember/LOCQ)]
 (c) Give an overview of cell signalling pathways involved in bone tissue engineering. [[CO2](Remember/LIOCQ)]
4 + 4 + 4 = 12
3. (a) Elucidate the formation of different organs from ectoderm, endoderm and mesoderm. [[CO1](Understand/LOCQ)]
 (b) Analyze with a diagram the formation of a four-chambered beating heart from a single tube. [[CO1](Analyze/IOCQ)]

- (c) What do you mean by 'Lines of Blaschko'? Give a critical appreciation of the significance of this discovery.

[[CO1](Criticize/HOCQ)]

4 + 4 + 4 = 12

Group - C

4. (a) Define Tissue Engineering and Biomaterials? [[CO3](Remember/IOCQ)]
(b) Classify Biomaterials and discuss the type "Polysaccharides as biomaterials" with suitable examples? [[CO3](Remember/LOCQ)]
(c) Explain the principles and applications of bioreactors in tissue engineering, with a focus on perfusion bioreactors? [[CO3](Apply/IOCQ)]

2 + 5 + 5 = 12

5. (a) What is silk fibroin? Describe the steps of extraction of silk from *Bombyx mori*. [[CO3](Analyse/HOCQ)]
(b) What is 3D-bioprinting? Write names of three types of 3D-printers. Explain principle of anyone type of bioprinter that you have mentioned with a labelled diagram. [[CO3](Remember/LOCQ)]

(1 + 5) + (1 + 5) = 12

Group - D

6. (a) (i) Write the names of three different techniques for preservation of cells or tissue. (ii) Describe any one of the cell preservation techniques that you mentioned. [[CO4](Analyse/HOCQ)]
(b) (i) Explain the Monod model for mammalian cell growth. (ii) Explain the kinetic model for contact inhibition of mammalian cells. [[CO4](Remember/LOCQ)]

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

7. (a) Discuss various types of stem cells in detail. [[CO5](Analyse/IOCQ)]
(b) Discuss in detail about Induced pluripotent stem cells. [[CO5](Remember/IOCQ)]

6 + 6 = 12

Group - E

8. (a) Justify with reasons the ethical issues involved in tissue engineering. [[CO6](Justify/OCQ)]
(b) Illustrate the application of nerve guides for repair of peripheral nerve injury. [[CO5](Understand/IOCQ)]
(c) Give a brief outline of regenerative therapeutic approaches using cochlear implants. [[CO5](Analyse/IOCQ)]

4 + 4 + 4 = 12

9. (a) Describe the role of type-I collagen in for use as biomaterial matrices in tissue engineering. [[CO3](Analyse/HOCQ)]

(b) What are the different approaches of diffusion-controlled release?

[[CO4](Remember/LOCQ)]

(c) Describe briefly the concept of zero order release.

[[CO2](Apply/IOCQ)]

4 + 4 + 4 = 12

Cognition Level	LOCQ	IOCQ	HOCQ
Percentage distribution	34.38	40.62	25.00