Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

VII SEMESTER B.Tech. (BME) DEGREE END SEM EXAMINATIONS NOVEMBER 2017
SUBJECT: TISSUE ENGINEERING (BME 4010)
(REVISED CREDIT SYSTEM)

Thursday, 23rd November 2017: 2 PM to 5 PM

TIME: 3 HOURS **MAX. MARKS: 100**

Instructions to Candidates:

1. **Answer all the five full questions.**
2. **Answer should be brief and to the point**

1A. Discuss the major components of cartilage, and explain why cartilage has limited capacity to get repaired. **6**

1B. State clearly the principles associated with the following sterilization methods:
(i) UV ray sterilization, and (ii) moist heat sterilization. **4**

1C. A bioengineer is asked to extract collagen for the fabrication of a composite matrix (for designing a femoral prosthesis). **10**

(i) Compare the steps involved in the isolation of soluble and insoluble collagens.

(ii) After isolation, which one would be suitable for the fabrication of the composite matrix?

(iii) How can you sterilize both the isolated collagens and matrices?

Explain with proper reasons.

2A. Explain the impact of sterilization on the following polymers: **8**

(i) polymethyl-metha acrylate (melting point 130^{o}C) (by dry heat),
(ii) polyamide (melting point 200^{o}C) (by dry heat),
(iii) polyamide (by moist heat) and
(iv) polyolefin (exposure 10^{6}) (by gamma rays)

2B. Explain the developmental fate map associated with the cardiovascular system. **8**

2C. Discuss briefly, the role of ‘transcription’ and ‘translation’ in gene activation process of cellular signaling. **4**

3A. Following are the cells involved in cellular signaling in bones: **8**
(i) Osteocyte, (ii) lining cell, (iii) osteoblast, and (iv) osteoclast.
Establish the interdependence among these cells with the factors regulating the signaling paradigm. Map the BMP regulated cell signaling pathways for bone formation (state clearly the role of each component).

3B. What is 'integrin'? How does integrin regulate 'outside-in' and 'inside-out' signaling (Be specific with the answer). **4**

3C. Discuss the steps involved in the isolation of human embryonic stem cells (IVF Process). **8**

4A. How would you evaluate the regenerative potentials of both the isolated human embryonic stem cells and human hematopoietic stem cells (isolated from placenta) by *in vivo* process? **8**

Categorize stem cell niche.

4B. Chitosan is a biopolymer extracted from waste materials (exoskeleton of prawn). How would you use chitosan to fabricate interconnected porous scaffolds? Write down your strategies in a brief and logical manner. **4**

4C. Explain the working of the following selection process (i) isopycnic gradient centrifugation and (ii) antibody panning. **8**

5A. Explain steps associated with autologous chondrocyte implantation (ACI). **6**

5B. You have harvested chondrocyte, hepatocyte and osteocytes from a human subject (primary culture). How would you: **2+2+4**
(i) Select specifically chondrocyte from the heterogenous population
(ii) convert them to cell line

(iii) Comment on whether FACS study could be appropriate for selecting the above cells. After selection, how would you maintain and preserve these cells? In this context, analyze the roles of dimethyl sulfoxide and polyethylene glycol for cell preservation.

5C. (i) In the superficial and trans-zonal region of an articular cartilage, collagen fibers are horizontally oriented. Indicate the significance of such orientation. **2x3**

(ii) What would happen if you use a membrane filter of pore size 0.01 µm alone to remove all microorganisms including viruses, instead of stepwise removal using membrane filters of pore size 0.2 µm and 0.01µm?

(iii) How would stem cell niche respond to extrinsic cell signaling?