Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

II SEMESTER M.TECH (BIOMEDICAL ENGINEERING)

END SEMESTER EXAMINATIONS, MAY 2016

SUBJECT: BIOMATERIALS & ARTIFICIAL ORGANS [BME 520]

REVISED CREDIT SYSTEM
TUESDAY, MAY 10TH, 2016: 9.00 AM-12.00 NOON

Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions from **PART A** and **PART B.**
- Draw labeled diagrams wherever necessary.
- Use separate answer book for PART A (**Biomaterials (Q.1-3)**) and PART B (**Artificial Organs (Q.4-6))**

PART A: Biomaterials

1A. Explain the mechanism associated with bio-erosion of biodegradable polymers. **5**

1B. You are asked to design a composite material from carbon fiber and resin for a fracture plate. The following data are given- **5**

Materials	E (GPa)
Carbon fiber	210
Resin	30

What volume of carbon fiber will be required to make the modulus of the composite plate 100 GPa? Assume that the fibers are aligned in the direction of test and $V_{matrix} + V_{fibers} = 1$

1C. Compare 'rule of mixture' and 'inverse rule of mixture' of a fibre reinforced composite. **5+5**
Explain the steps involved in 'investment casting' of Co-Cr based alloy.

2A. Discuss the steps involved in the fixation of endosteal type of dental implants. **5**

2B. Establish and compare the expressions deduced using spring and Newtonian dashpot in the context of visco-elastic behavior of bone. **10**

2C. A stress of 1MPa was required to stretch a 2cm aorta strip to 2.3 cm. After an hour in the stretched position, the strip exerted a stress of 0.75 MPa. Assume the mechanical property of the aorta did not vary appreciably during the experiment. Calculate the relaxation time as per simple exponential decay model. **5**

3A. A sample of monomer $(-CH_2-CH-CH_3)n$ is polymerized. Can it exist in both amorphous and crystalline form? Explain. **2**

3B. You are asked to extract collagen for the fabrication of a composite matrix. What type of isolation technique would be appropriate? Describe the steps in brief, and justify your choice. Will the orientation of the collagen fibres make any impact on the design of the composite matrix? Do the absence of proline and hydroxyproline in collagen molecule have any impact on its structure? **3+3+2**

3C. Distinguish between : **5x2**

(i) dendrimer and graft copolymer, (ii) thermoplastic and thermosetting, (iii) cast and malleted gold, (iv)Pitting and stress corrosion cracking, (v) hydroxyapatite and beta-whitelockite.

PART B: Artificial Organs

4A. What are the benefits and complications associated with a ceramic hip prosthesis? **4**

4B. A patient in cardiac failure needs an assistive device. Surgery is not an option. The cardiologist asks for your help. Imaginatively design a pump to help this patient. There is no text book answer. We do not want to use a conventional IABP. Any solution is acceptable as long it is logical and you can defend it. **8**

4C. (i) Discuss in detail, different types of Tissue valves. **4 + 4**

(ii) Explain, with necessary diagrams, the construction of a stent mounted tissue valve. Label all the parts clearly and explain step by step how the valve is constructed.

5A. (i) What are the differences in the characteristics of membranes used for Hemodialysis and Membrane lung? **2+2**

(ii) Can the membrane used for hemodialysis be used for peritoneal dialysis? Why or Why not?

5B. Explain the need for a bio-reactor in an artificial liver system. Why not just use a Chemical absorbent or adsorbent? **6**

5C. Discuss in detail the challenges in designing an Implantable Artificial Kidney and how these challenges are being overcome in the Implantable Artificial kidney under development at University of San Francisco. Your discussion should focus on the technologies used. Do not discuss biocompatibility issues. **10**

6A. What are Type I and Type II diabetes? **4**

6B. Discuss the role of Insulin and Glucagon in controlling blood sugar. **6**

6C. You are asked to design a wearable insulin pump (not an implantable one). What are all the parameters you will consider in designing a control system for insulin delivery? With a block diagram, explain how you will go about designing a control system for such a pump. **10**