Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY

MANIPAL

A Constituent Institution of Manipal University

II SEMESTER M.Tech DEGREE END-SEM EXAMINATIONS APRIL/MAY 2017
SUBJECT: BIOMATERIALS AND ARTIFICIAL ORGAN (BME 5231)
(REVISED CREDIT SYSTEM)

Tuesday, 25th April 2017: 9 AM to 12 Noon

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

Instructions to Candidates:

Answer all five full questions.
Use separate answer book for Biomaterials (Q.1-3) and Artificial Organ (Q. 4-5)

1A. Classify different types of ceramics based on their chemical reactivity. Explain the role of 'nucleation' and 'crystal size' in the fabrication of glass ceramics. **2+3**

1B. Type 316L Stainless steel has a maximum carbon content of 0.03% whereas type 316 stainless steel has a carbon content 0.7%. Explain how you would expect the mechanical properties to differ from each other. Justify your answer.
How would the corrosion of metallic implants affect the host tissues? **2+3**

1C. Analyze mathematically as to how the direction of force will affect the modulus of a continuous –aligned fiber-reinforced composite.
Explain how the incorporation of a plasticizer and cross-linker will influence the modulus of a polymer? **5+5**

2A. Compare "creep" and "relaxation" in the context of viscoelastic property of a material.
Deduce an expression for viscoelastic property of bone using Voight Model. **4+6**

2B. An applied strain of 0.04 produces an immediate stress of 10MPa in a piece of rubber, but after 42 days, the stress is only 5 MPa. Calculate the relaxation time (τ).
What will be the stress after 90 days? **4**

2C. With a neat sketch, mention the different materials constituting a knee joint implant.
Compare 'endosteal' and 'subperiosteal' types dental implants. **3+3**

3A. How do 'tacticity' and 'glass transition temperature (Tg)' of a polymer influence its mechanical properties? **5**

3B. You are asked to extract collagen for the fabrication of a composite matrix to be used for making the stem part of the Total Hip Replacement (THR). 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? **3+3**

3C. Compare: (i) chain growth polymerization and step growth polymerization, (ii) thermoplastic and thermosetting, and (iii) cast and malleted gold, **3+3+3**

4A. Hemodialysis works on the principle of removal of solutes based on their concentration gradient. Develop an equation for Clearance rate of Urea from blood based on concentration gradient. State clearly, all your assumptions. Assume that there is NO ULTRAFILTRATION. **8**

4B. In what way will ultrafiltration affect solute removal? **3+4**
Why do we add Bi-carbonate and Citric acid in the dialysate liquid?

4C. Discuss in detail, the difference between a ball valve and single disc valve in terms of their performance characteristics. **5**

5A. Differentiate clearly Type II and Type I diabetes. **3**

5B. Why do we need ultrafiltration? How can you achieve ultrafiltration in Peritoneal dialysis? **5**

5C. Explain the basic causes of liver failure. **5+7**
You are asked to design a modern implantable insulin pump.

i. List all the major performance constraints that have to be taken into account during the design.

ii. Draw a block diagram showing all the major parts of the pump.