Reg. No.										

Manipal Institute of Technology, Manipal

(A Constituent Institute of Manipal University)

V SEMESTER B.TECH (BIOMEDICAL ENGINEERING)

END SEMESTER EXAMINATIONS, NOV/DEC 2015

SUBJECT: BIOMATERIALS & ARTIFICIAL ORGANS [BME303]

REVISED CREDIT SYSTEM
Friday, November 27, 2015: 2pm-5pm

Time: 3 Hours MAX. MARKS: 100

Instructions to Candidates:

- Answer **ANY FIVE FULL** questions.
- Draw labeled diagrams wherever necessary.

1A. Highlight the factors that limit the application of PMMA as (i) bone cement for Total Hip Arthoplasty, (ii) soft contact lens. **6**

1B. A bioengineer is asked to fabricate a bone fracture plate from the following materials: [316LSS, ALCAP, Ti6Al4V, UHMWPE (creep)]. **6**

Which one would (s)he choose
(i) Only for strength?
(ii) Only for biocompatibility?
(iii) Only for its "stress shielding osteoporosis"?
Justify your answers
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1C. Discuss the steps involved in the fixation of Total Hip arthroplasty. Highlight the pros & cons of cemented and cement-less fixation. **8**

2A. Explain the conditions required for fabrication of Hydroxyapatite and Beta–Whitelockite. Highlight the advantages of coating a Ti based dental implant with hydroxyapatite. **6**

2B. 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 in the design of the composite matrix? Do the absence of proline and hydroxyproline in collagen molecule have any impact on its structure? **10**

2C. A sample of polypropylene molecule $[-CH_2CHCH_3]_n$ is polymerized. Can it exhibit both amorphous and crystalline nature? Will it show different values of young's moduli? Explain. **4**

3A.	Establish an expression for the relaxation time (T) over which stress decays to 1/e of its original value in the context of viscoelastic behavior of bone model.	**8**
3B.	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. What is the relaxation time as per simple exponential decay model?	**6**
3C.	Discuss the different classes of ceramics and composites.	**6**
4A.	Compare the Ball Valves and Tilting Disc Valves in terms of performance and clinical use in mitral and aortic positions. (Each point should be discussed briefly. One word answers are not enough.)	**4**
4B.	In a wear tester, the sewing ring material of a valve tore after 50 million cycles of heart beat. All the other parts were functioning normally. What will be your decision on the use of this type of valve for clinical purposes? Justify your answer.	**6**
4C.	With a diagram, explain the function of a pulse duplicator and how it can be used to test heart valves. (Be specific about the function and role of each major component of the pulse duplicator, the measurements and the parameters of the valve that are tested and so on. Generalised answers are not acceptable.)	**10**
5A.	What are the problems associated with the use of a 'metal on metal' hip joint?	**4**
5B.	Discuss the problems associated with an 'all plastic' design of an artificial knee.	**6**
5C.	Describe a non-pulsatile blood flow pump as a cardiac assist device. Discuss the design, materials used and problems encountered in clinical use.	**10**
6A.	Using a block diagram, describe the working of a wearable artificial kidney.	**8**
6B.	What are the basic causes of Liver failure? Enumerate the basic functions of a natural liver. Why is it necessary to have a bioreactor as a part of the artificial liver?	**8**
6C.	During haemodialysis, how is the fluid volume of the patient controlled?	**4**