Reg. No.											

MANIPAL INSTITUTE OF TECHNOLOGY

(A constituent unit of MAHE, Manipal 576104)

V SEM B.Tech (BME) DEGREE END SEMESTER EXAMINATIONS, NOVEMBER 2019.

SUBJECT: BIOMATERIALS AND PROSTHETICS (BME 3103)
(REVISED CREDIT SYSTEM)
Monday, 18th November, 2019, 2 to 5 PM

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to Candidates:

1. **Answer ALL questions.**
2. **Use separate answer book for Biomaterials (Q.1-3) and Artificial Organs (Q.4-5)**

1A. Differentiate 'creep' and 'relaxation' behavior in the context of viscoelastic model of material. Using a spring and Newtonian dashpot, derive an expression for the viscoelastic behavior of bone applies to Maxwell model. (2+5)

1B. An applied strain of 0.4 produces an immediate stress of 10 MPa in a piece of rubber, but after 42 days the stress is only 5 MPa. What is the relaxation time (T)? 3

2A (i) How do polypropylene molecules exhibit both amorphous and crystalline structures? (2+3)
(ii) The ability of elastic and plastic materials to deform depends on the ability of polymer chains to move. Analyze critically the impact of hindering this chain motions on the mechanical properties of polymer.

2B (i) Compare particle reinforced and fiber reinforced composites. (2+3)
(ii) Does direction of force have any role in measuring modulus of the fiber reinforced composites? Justify your views.

3A How does endo-steal dental implants differ from sub-periosteal design? Explain briefly (with necessary diagram). 2

3B (i) Does "central blood flow" have any impact on long term clinical application of mechanical heart valve prosthesis? (2+3)
(ii) What are some of the advantages and disadvantages of porous materials (for the attachment of joint replacement) when compared with PMMA bone cement fixation?

3C	Explain the mechanisms for tuning the degradation of polymer.	3
4A	With a diagram, explain the working of an accelerated wear tester for heart valves; the need for such testing and how accelerated testing is achieved in the wear tester.	(3+1+2)
4B	A new heart valve under development has high opening pressure and high forward flow resistance but has very low regurgitation in a pulse duplicator. What will be the clinical implication if the valve is approved for mitral or aortic replacement? (In other worlds, how will it affect the patients?)	3
4C	List three key problems encountered in using an External Counter Pulsation Device for cardiac support.	1
5A	Explain the role of glucagon in controlling glucose in the body?	1
5B	You are asked to design a completely implantable and self-contained glucose control system for insulin dependent patients. (i) Draw a block diagram for such a system. Clearly show all the subsystems right from electrical aspects to the delivery point and explain briefly how the system is expected to work. (ii) What are all the points you should consider in designing the control logic for insulin delivery.	5
5C	Discuss the causes and the process of loosening of knee / hip prostheses.	3
5D	How is a mobile bearing knee and different from a fixed bearing knee? Explain with diagrams. Where are they used?	1