Exam Date & Time: 19-May-2022 (10:00 AM - 01:00 PM)

MANIPAL ACADEMY OF HIGHER EDUCATION

VI SEMESTER B.TECH END SEMESTER EXAMINATIONS, MAY 2022

BIOMATERIALS [BME 4051]

Marks: 50 **Duration: 180 mins.**

A

Answer all the questions.

Instructions to Candidates:
Answer ALL questions Missing data may be suitably assumed

1) Describe two techniques commonly used for making polymeric tissue engineering scaffolds. Can these same techniques be used for ceramics? If not, then explain why? (4)

A)

B) Explain the difference between branched and cross-linked polymers. Which would be expected to be stiffer? Why? (3)

C) Highlight and comment on the different criteria that natural materials need to satisfy in order for them to be used in biomedical applications. (3)

2) What do you mean by linear homo-polymer and graft copolymer? Between these two classes of polymers, which one do you think would have higher mechanical strength? (2)

A)

B) How is bone density measured? Analyse the impact of the difference in bone density pertaining to fixation of dental implant. Comment on the significance of ‘’sinus lift” in the upper jaw for placing the dental implant. (4)

C) Why are patients undergoing mechanical heart valve replacement advised anticoagulant therapy throughout their life? Compare the advantages and disadvantages of mechanical and bioprosthetic heart valves. Does “central blood flow” have any impact on long term clinical application of mechanical heart valve prosthesis? Justify your view with reason. (4)

3) Compare particle reinforced and fiber reinforced composites. Does direction of force have any role in measuring modulus of the fiber reinforced composites? Justify your views (you can explain mathematically). (5)

A)

B) You are asked to design a composite material from carbon fiber and resin for fracture plate. The values of the modulus of carbon fiber and resin are 300 GPa and 30 GPa respectively. What volume of carbon fiber will be required to make the modulus of the (3)

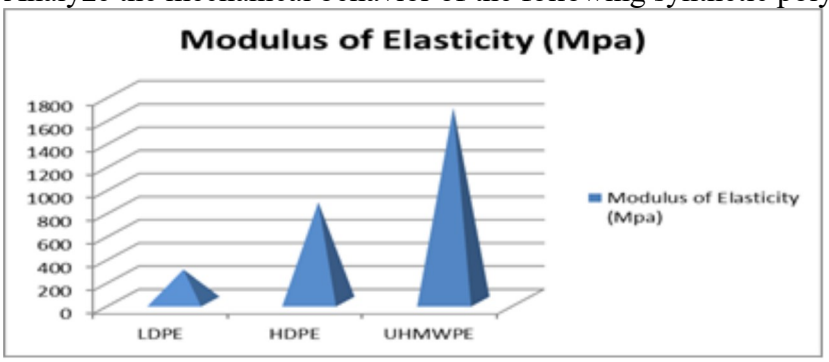
composite plate 100 GPa? Assume that the fibers are not aligned in the direction of the test (force is acting perpendicular to the direction of fibers).

C) 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. (2)

4) Analyze the role of impurity in deciding the mechanical properties of commercially pure titanium? (2)

A)

B) Analyze the mechanical behavior of the following synthetic polymers from the graph



(4)

UHMWPE is used to develop the femoral stem of THA. However, due to the generation of wear particles by the polymer osteolysis occurs. Suggest a method to mitigate this issue.

C) What is the basic difference between hemi hip and total hip prosthesis? You are given with a two different models of hip implants (THR). The stem of the first one is smooth and the other one is made rough and porous. Which one do you think would be ideal for hip joint replacement? Justify your answer. (4)

5) How do self-expanding stents made from Nitinol work? (2)

A)

B) 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? Does the absence of proline and hydroxyl-proline in collagen molecule have any impact on its structure? (5)

C) How do you assess porosity of a scaffold? Briefly, elaborate the process involved in any one of the commonly used methods. (3)

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