Reg. No.										

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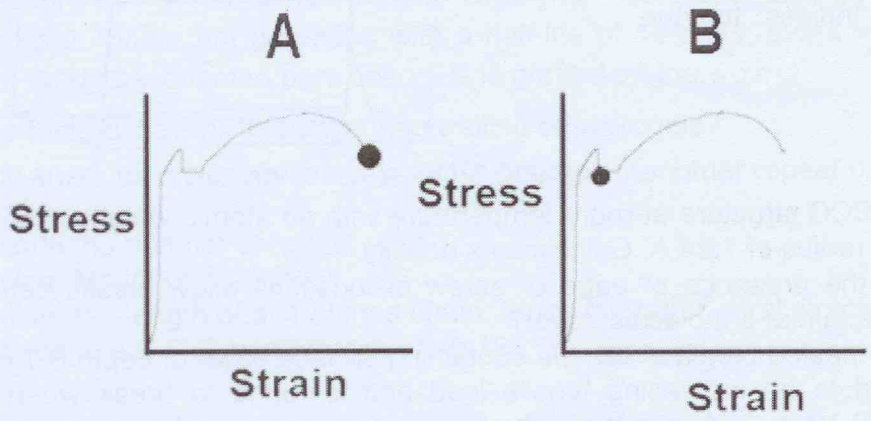
VI SEMESTER B.TECH. (BIOTECHNOLOGY)
END SEMESTER EXAMINATIONS, APRIL 2018

SUBJECT: BIOMATERIALS [BIO 4009]
REVISED CREDIT SYSTEM

Time: 3 Hours MAX. MARKS: 50

Instructions to Candidates:

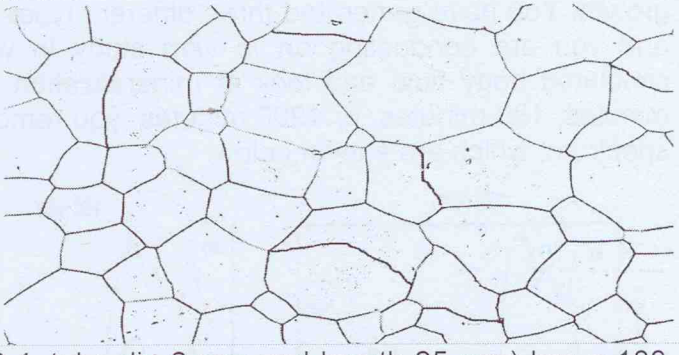
- Answer **ALL** the questions.
- Missing data may be suitable assumed.

1A. 

Label the points A & B shown in stress strain curve? Explain. 2

1B. Some biomaterials do not normally induce adverse tissue responses when implanted in bulk form. However, some of these same materials would be non-biocompatible in powder (or particulate) form. Explain why. 2

1C. Determine the ASTM grain size using number of grains in the metal specimen per square inch measured at a magnification of 100X? For this same specimen, how many grains per square inch will there be at a magnification of 85X? 2



1D. A rubber drain tube (poisson's ratio 0.4, tube dia 8 mm and length 25 mm) has a 100 N normal force applied outwards producing an extension of 0.02 mm between those faces. Calculate ***i)*** Normal stress ***ii)*** Normal strain ***iii)*** Young's modulus ***iv)*** the decrease in its diameter. 4

2A. Why do you suppose a cell relies on the strategy of polymerizing and depolymerizing cytoskeletal filaments, rather than on diffusion of the filaments themselves, to accomplish its cytoskeletal rearrangements? 3

2B. Microinjecting cytochrome c into the cytosol of wildtype mammalian cells and of cells that were doubly defective for Bax and Bak. Would you expect one, both, or neither type of cell to undergo apoptosis? Explain. 3

2C. What is "cyclic" about cyclic AMP? 2

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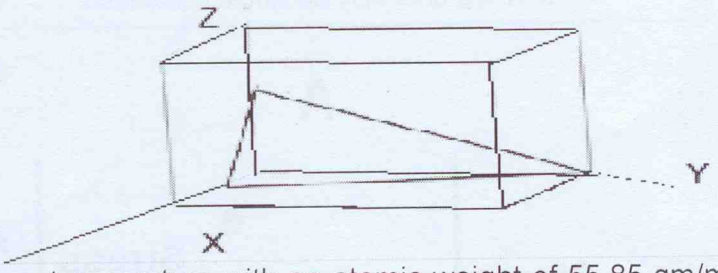
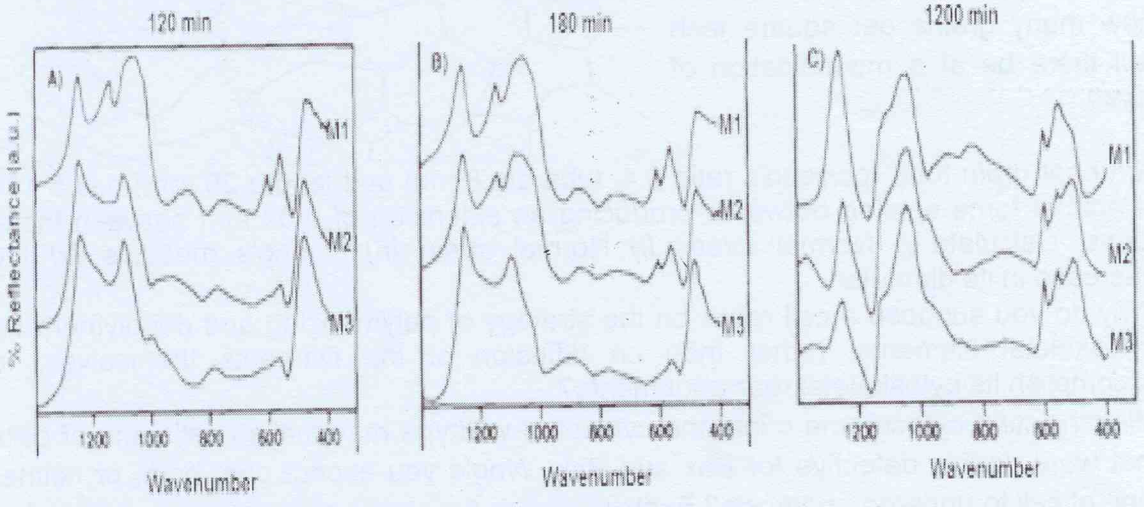
2D.	How do you access a biomaterial using MTT cytotoxicity assay?	2
3A.	Alloys are increasingly used versus pure metals for biomedical applications. What two major advantages do they impart? Describe how the difference in atomic makeup of pure metals versus alloys contributes to these advantages.	2
3B.	Explain miller indices measuring procedure. Find the miller indices for the given plane. 	2
3C.	Iron has a BCC structure at room temperature with an atomic weight of 55.85 gm/mol and atomic radius of 1.24 A. Calculate its density.	4
3D.	Why does the presence of edge or screw dislocations allow plastic deformation of metals? Explain at a molecular level?	2
4A.	A freshly annealed bioglass sample containing surface flaws of depth 0.1 micro meter is subjected to an increasing tensile load and is found to break when the stress reaches 140 MNm-2. Assuming plane strain conditions and the geometric parameter Y, calculate K1c of the glass.	2
4B.	What are piezoelectric ceramics? Mention the design considerations required for the piezoelectric implant that has to be used for hard tissue?	2
4C.	You are trying to generate a scaffold for bone tissue engineering that promotes bone growth. You have generated three different types of bioactive glass (M1, M2, and M3) and you are conducting an *in vitro* study in which you incubate the scaffolds in simulated body fluid and look at mineralization on each material over time. At 120 minutes, 180 minutes, or 1200 minutes, you remove the samples and analyze their IR spectrum, which are shown below 	6

You are also provided with information regarding the IR frequencies absorbed by certain chemical groups. Specifically, formation of hydroxyapatite (the mineral component of bone) is characterized by generation of a P-O bond undergoing bending vibrations.

Groups	Wavenumber Range(cm-1)
Si-O-Si	1175-860
Si-OH	549-470
P-O	600-560

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	i) Which material begins to form mineralized hydroxyapatite first? How do you know? ***(2)*** *ii)* Which material undergoes the most significant amount of mineralization by 1200 minutes? Justify your answer using the IR spectra. ***(2)*** *iii)* You find a paper that reports that a linear relationship between time and Mineralization during the first day is best for supporting the osteogenic differentiation of mesenchymal stem cells. Which material would you select for your studies and why? ***(2)***	
5A.	Discuss the working principle in electro spinning for creating nano wires.	**2**
5B.	Below given statement is for regenerative synthetic polymer, provide your positive and negative responses. "A synthetic porous copolymer of lactic acid/glycolic acid, comonomer ratio 75/25, that degrades with a half-life of 14 days, average pore size 100 μm, with randomly oriented pore channels is grafted on the wound".	**3**
5C.	What are the factors that will influence the swelling of hydrogels?	**2**
5D.	PE is used in knee. Its molecular weight= $2x10^6$ gm/mol. Monomer repeat unit=-(CH2-CH2-). ***i.*** Calculate the number of repeat units ***ii.*** Calculate Mn if polydispersity ***iii.*** Calculate the length of a stretched chain. Since the tetrahedral structure of the carbon leads to a C-C-C bond length of =0.126 nm.	**3**