UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2014/2015

COURSE NAME	:	BIOMATERIALS
COURSE CODE	:	BEU 41103
PROGRAMME	:	BACHELOR DEGREE OF ELECTRONIC ENGINEERING WITH HONOURS
EXAMINATION DATE	:	JUNE 2015 / JULY 2015
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ALL** QUESTIONS

THIS QUESTION PAPER CONSISTS OF **SIX(6)** PAGES

Q1 (a) Draw the structure of a bone and label the microstructures of the bone.

(2 marks)

(b) Suggest and explain **FOUR (4)** techniques that can be used to examine the neoplastic diseases of the soft tissues.

(6 marks)

(c) You are evaluating a synthetic scaffold for repair of cartilage defects. Following the implantation of the material and the formation of new tissue within the effect, suggest the techniques you would use to determine the protein content of the newly formed tissue.

(6 marks)

(d) Most tissues in the human body are relatively soft compared to bone. Explain the function of high modulus bone. State the considerations of the modulus in designing a synthetic scaffold material to replace bone via tissue engineering approach.

(6 marks)

Q2 (a) Draw and explain the post-translation process for the synthesis of collagen fibers.

(8 marks)

(b) Chitosan are extracts from shrimp shell and has been incorporated into many new hydrogels design.

(i) Suggest the **TWO (2)** advantages and disadvantages of Chitosan in the design of the biomaterial.

(4 marks)

(ii) The mechanical properties are important to ensure that the cells are adaptable to the stiffness of the material and restructure themselves accordingly. Suggest and design **TWO (2)** techniques that could be used to assess the **TWO (2)** physical properties of a chitosan doped PEG.

(4 marks)

(iii) Deduce the expected stress strain response of the chitosan hydrogel.

(4 marks)

Q3 (a) Figure **Q3(a)** shows the femoral component of the hip implant coated with a type of coating.

(i) Suggest a biomaterial which is suitable to be the coating of the femoral.

(2 marks)

(ii) Figure **Q3(b)(ii)** shows the FESEM images of cell morphology on the surfaces of HA-240 discs after incubation with cells at different time points: (A) 1 day; (B) 3 days; (C) 5 days; and (D) 8 days. Inserts are higher magnification views of cell morphology. Analyse and explain the observations in Figure **Q3 (b)(ii)**.

(6 marks)

(iii) Identify **TWO (2)** other applications and explain the applications briefly for this type of biomaterial.

(4 marks)

(b) Polyethylene Glycol (PEG) was found to be bio-inert but it has the advantage of being tuneable and biocompatible. Recommend strategies and molecules that can reduce the bio-inertness to cell adhesion.

(4 marks)

(c) You are considering a new material for use as contact lenses. Preliminary studies involving mechanical properties assessment of the material are promising. Subsequent in vivo studies with human tested ex-vivo indicate that the material caused dryness and redness of eyes for extended period of time. The test subject also complained that their eyes experience flashes of lights during night driving. Justify and explain the reasons for the biological response observed.

(4 marks)

Q4 (a) Explain the difference between biological and chemical inert.

(3 marks)

(b) Figure **Q4(b)** shows a photomicrograph of a Scanning Electron Microscopy (SEM) of chondrocytes adhering to poly(l-lactide) (PLLA) microspheres.

(i) By using a diagram, evaluate and explain various types of biological macromolecules involved with the adhesion of cells to the PLLA microspheres.

(8 marks)

(ii) Deduce the organisation of the cytoskeleton in the chondrocytes and explain briefly the reason the cell expressed such characteristic.

(3 marks)

(c) Figure **Q4(c)** is the chemical structure of amoxicillin. Identify and draw the **SIX (6)** functional groups that you can identify.

(6 marks)

Q5 (a) Explain briefly the characteristics of the **THREE (3)** extracellular matrix proteins that are the main constituents of basement membrane.

(6 marks)

(b) In your research lab, you are required to develop a hyrogel that can be used for skin graft scaffolds.

(i) Suggest a composite hyrogel that can achieve the objective as an implant.

(2 marks)

(ii) Design and describe the protocols that can be used to produce this hydrogel.

(4 marks)

(iii) Since the sample is in three dimesional, it is difficult to image the gel using optical microscopy. Explain briefly a technique that can be used to analyse the internal structure of the hydrogels.

(4 marks)

(iv) Predict and explain briefly **TWO (2)** problems with this hydrogels when it is applied for cell culture in-vitro.

(4 marks)

- END OF QUESTION –

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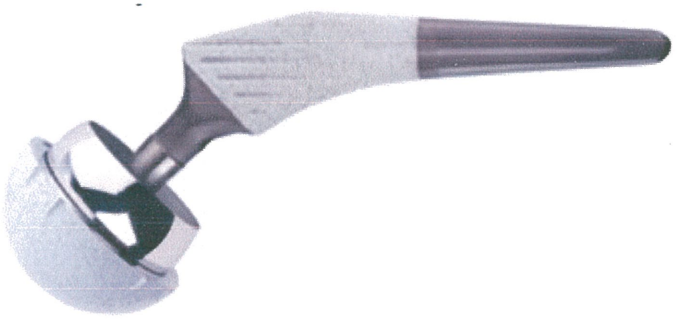

FIGURE Q3(a)

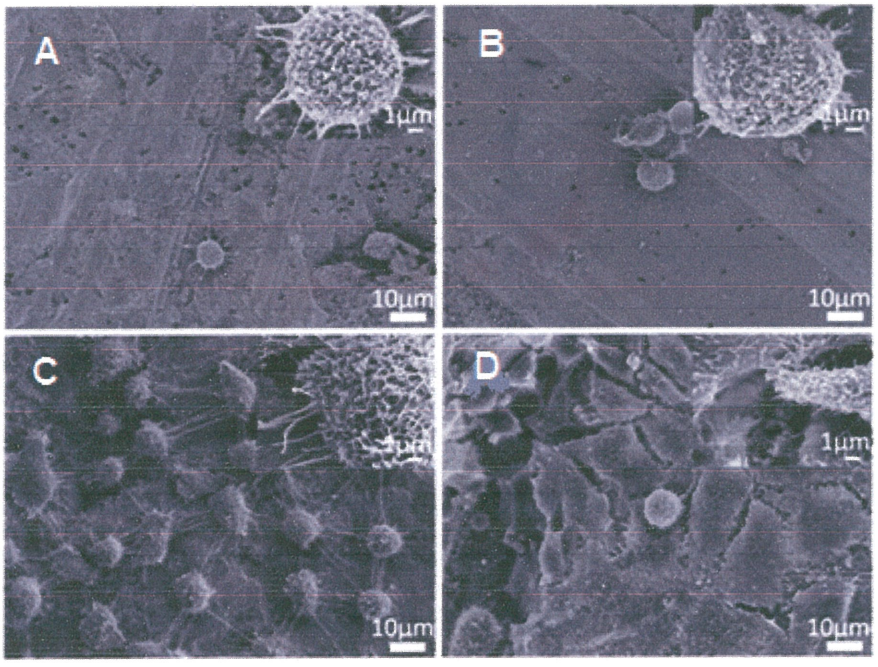

FIGURE Q3(b)(ii)

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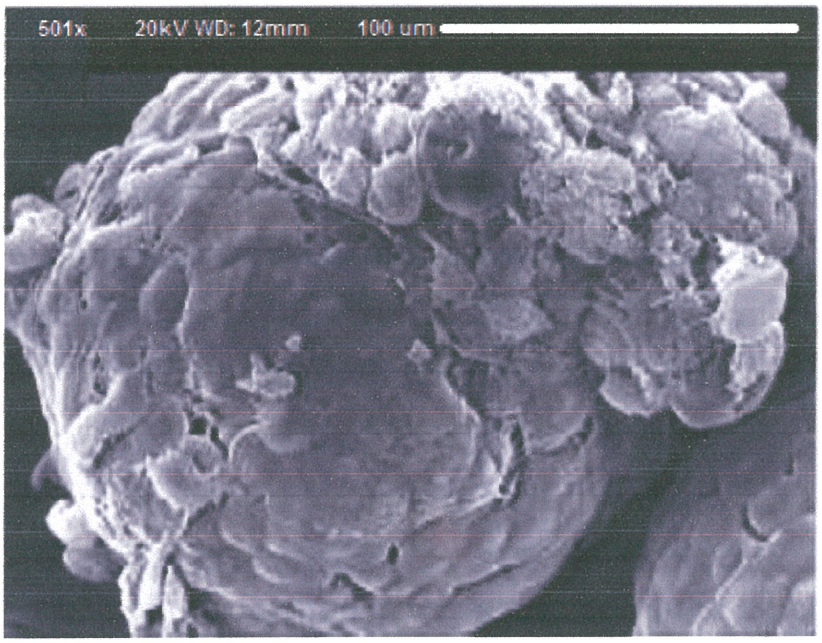

FIGURE Q4(b)

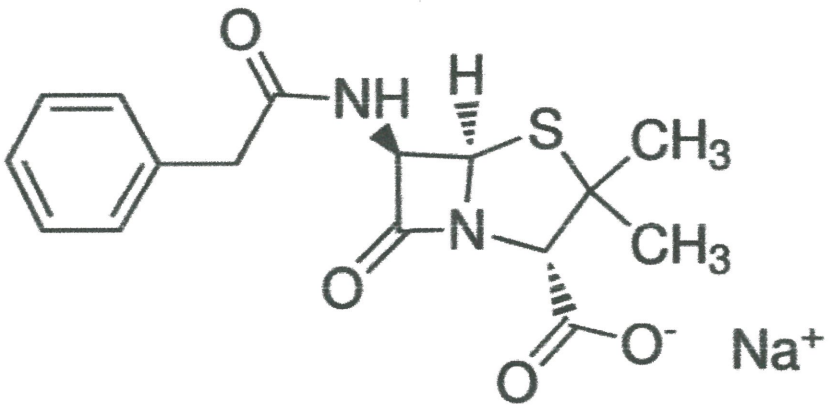

FIGURE Q4(c)