



UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION  
SEMESTER II  
SESSION 2023/2024

- COURSE NAME : BIOMATERIAL
- COURSE CODE : BEJ 45603
- PROGRAMME CODE : BEJ
- EXAMINATION DATE : JULY 2024
- DURATION : 3 HOURS
- INSTRUCTIONS :
1. ANSWER ALL QUESTIONS
  2. THIS FINAL EXAMINATION IS CONDUCTED VIA
    - Open book
    - Closed book
  3. STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF FIVE (5) PAGES

**Q1** Figure Q1.1 shows the histological section stained with Hoechst & Eosin dyes for an unknown tissue.

- (a) Identify parts A, B, and C of the tissue shown in **Figure Q1.1**, respectively.

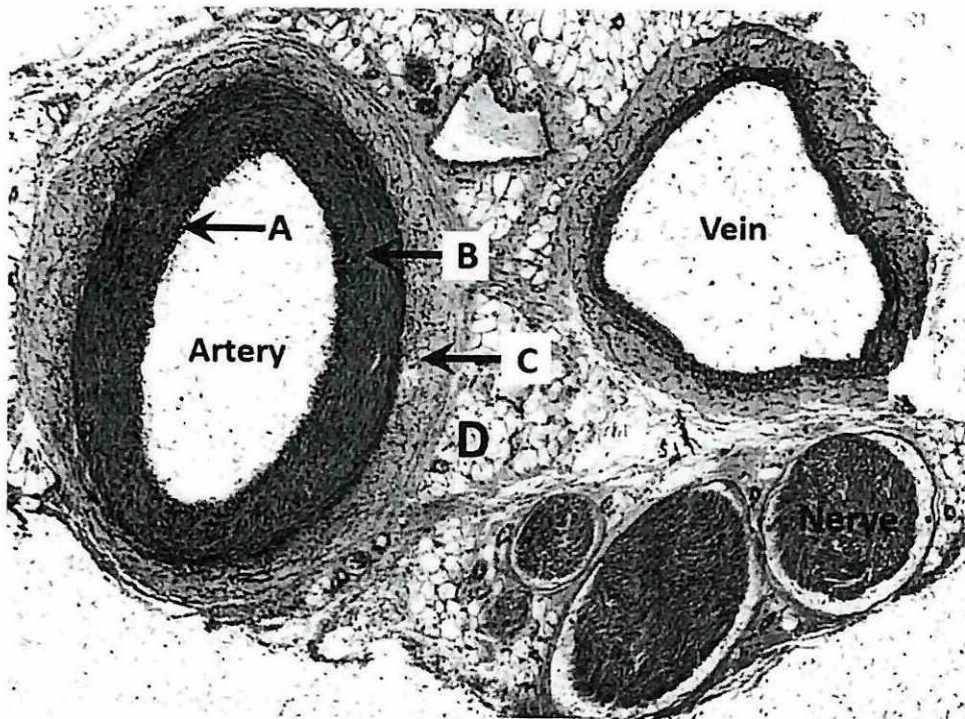
(6 marks)

- (b) Explain the function of the cells and tissue microstructure identified for parts A, B, C and D in **Figure Q1.1**, respectively.

(12 marks)

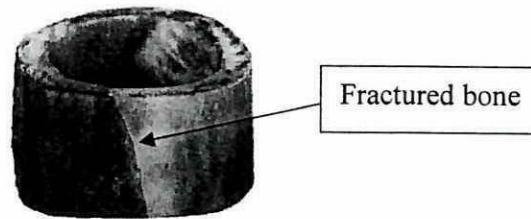
- (c) Suggest and explain a biomaterial that is potentially suitable to be applied as biomaterial to repair the tissue labelled as C in **Figure Q1.1**.

(2 marks)



**Figure Q1.1**

- Q2** A femur bone of a porcine was found fractured after undergoing a torsion test. The fractured bone is shown in **Figure Q2.1**.

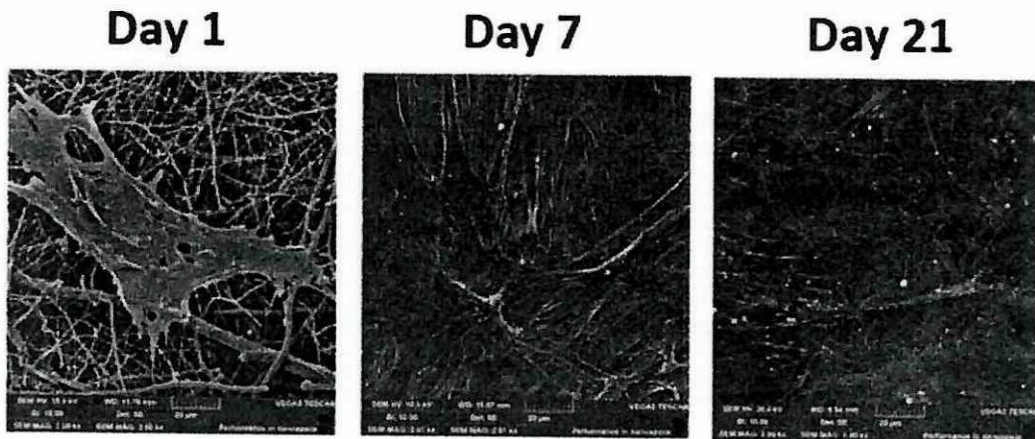


**Figure Q2.1**

- (a) Identify and state the function of protein macromolecules of the bone as shown in **Figure Q2.1**.  
(4 marks)
- (b) Draw and label **THREE (3)** microstructures and explain the functions of these microstructures.  
(12 marks)
- (c) Explain the macromolecules and process that form this hard bone.  
(4 marks)
- Q3** Polyhydroxybutyrate (PHB) is one of the polyhydroxyalkanoates (PHAs), which has biodegradable and biocompatible properties. They are adopted in the biomedical field, such as medical implants and drug delivery carriers.
- (a) Design and draw a scaffold of PHB. Suggest and explain a suitable fabrication method for manufacturing this scaffold. Justify your choice of method for fabricating the scaffold.  
(6 marks)
- (b) Identify and explain **ONE (1)** method to assess the biocompatibility, biodegradation and material characterisation of the scaffold PHB.  
(12 marks)
- (c) Suggest **TWO (2)** molecules that can be included in the scaffolds to enhance tissue regeneration or prevent infection at the implant site.  
(2 marks)



- Q4** Fibrous scaffolds are desired in tissue engineering applications for their ability to mimic extracellular matrix. The polycaprolactone fibrous scaffold in **Figure Q4.1** was prepared using a combination of melt-blown and electrospinning technology. Both techniques seem to be promising for bone regeneration. **Figure Q4.1** shows the growth of osteoblasts on the nano fibres scaffolds from Day 1 to Day 21, in which the cells were grown confluent on the surface of the scaffolds on Day 7.



**Figure Q4.1**

- (a) Identify and explain briefly **THREE (3)** main proteins on the cell membrane expressed that aided the adhesion of the cells on the scaffolds of nano-fibres as shown in **Figure Q4.1**.  
(6 marks)
- (b) Draw and explain **THREE (3)** types of proteins mediating the cell-cell adhesion shown in **Figure Q4.1** (Day 21).  
(12 marks)
- (c) Analyze and explain the cytoskeleton and focal adhesion of the cell as observed on Day 1 culture in **Figure Q4.1**.  
(2 marks)

- Q5** Evaluating the biocompatibility of biomaterials is a critical step in biomedical research and the development of medical devices and implants. Biocompatibility refers to the ability of a material to perform its intended function without eliciting any adverse pathobiological response to the host organism.

- (a) Stents are commonly made from metal alloys, such as stainless steel, cobalt-chromium, or nickel-titanium (Nitinol). Analyze the pathobiological response of the host system if a stent is contaminated with fluorine.

(2 marks)

- (b) Several techniques are employed to evaluate the biocompatibility of biomaterials. Fill up all the fields in section (I) to (IX) of **Table Q5.1**.

(18 marks)

**Table Q5.1**

<b>Biocompatibility assessment techniques</b>	<b>Principle of operation</b>	<b>Types of assay or techniques</b>
(I)	(II)	(III)
<b>Mechanical assessment</b>	<b>Principle of operation</b>	<b>Types of experiment</b>
(IV)	(V)	(VI)
<b>Surface assessment</b>	<b>Principle of operation</b>	<b>Types of experiment</b>
(VII)	(VIII)	(IX)

**- END OF QUESTIONS -**