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**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2021/2022**

COURSE NAME : BIOMATERIAL

COURSE CODE : BEJ 45603

PROGRAMME CODE : BEJ

EXAMINATION DATE : JULY 2022

DURATION : 3 HOURS

INSTRUCTION : 1. ANSWER ALL QUESTIONS

2. THIS FINAL EXAMINATION IS AN  
**ONLINE ASSESSMENT AND  
CONDUCTED VIA OPEN BOOK**

THIS QUESTION PAPER CONSISTS OF **FIVE (5) PAGES**

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**Q1** **Figure Q1(a)** shows the photomicrographs of immuno-fluorescence imaging of a section of unknown tissue.

(a) Identify part A, B and C of the tissue as shown in **Figure Q1(a)**.  
(6 marks)

(b) Explain the function of the cells and tissue microstructure identified for part A, B and C in **Figure Q1(a)**.  
(12 marks)

(c) Explain a biomaterial which is suitable to fabricate an artificial tissue to repair this tissue labelled as C in **Figure Q1(a)**.  
(2 marks)

**Q2** (a) Laminin existence is a high molecular weight protein of extracellular matrix. It is one of the proteins found in the basal lamina and forks the protein networks of cells. Define laminin and its structure.  
(4 marks)

(b) Identify **TWO (2)** types of Collagens and the associated tissue available.  
(4 marks)

(c) The extracellular matrix (ECM) proteins are associated with ageing. Lost of skin elasticity, wrinkles sagging skin and stiff joints are the indications of lacking in a type of protein in the ECM. Name this type of protein. Postulate and analyze the consequences of not having this type of protein during wound healing.  
(8 marks)

(d) The integrin proteins  $\alpha3\beta1$  specific to Laminin binding is inhibited. Deduce the consequences of this inhibition.  
(4 marks)

**Q3** (a) ISO 10993-1:2018 contains the procedures suggested for the Biological evaluation of medical devices. In designing a medical device, the choice of the low-quality material with respect to its biocompatibility might result in a less functional medical device, biocompatibility being only one of a number of characteristics to be considered in making that choice. Where a material is intended to interact with tissue in order to

perform its function, the biological evaluation needs to be addressed. Suggest and explain **TWO (2)** in-vitro techniques that can be performed to evaluate the cytotoxicity of the implant.

(6 marks)

- (b) Biopolymer is an important example of biomaterials safe to be used in various applications such as implants and coatings. Give **TWO (2)** specific applications of biopolymer as biomaterials and justify **TWO (2)** reasons for each polymer suggested for the applications.

(6 marks)

- (c) In a cardiology department, a new batch of Drug Eluting Stent was purchased for patient with coronary artery disease. After the angioplasty procedure, the patient complaint of heart ache and failure in wound healing at the stent implant site. Perioperative complications and a thrombosis incidence were found at the stent implant site. The wire mesh of stent was removed and a new stent was replaced for the patient. Coating delamination was found on the wire mesh. As a biomedical engineer, suggest the origin of this problem and design consideration for DES?

(8 marks)

**Q4** Figure Q4 shows a table that compares the specific biomaterials, advantages, characterization methods and different examples of polymer, ceramic and metal as implant materials.

- (a) Fill up **TWO (2) answers** in the empty sections as stated from (i) to (xvi).

(16 marks)

- (b) If cells are to be cultured on a soft bed of Polycaprolactone (PCL), estimate the responses of the cytoskeletons on the hydrogels. Distinguish **THREE (3)** differences of the cytoskeleton expressions when the cells are cultured on the stainless steel L316 and on the PCL.

(4 marks)

**Q5** Figure Q5 shows an X-ray image of a total knee implant of Patient A. Patient A complained about pain at the knee and unhealed wound.

- (a) Deduce and explain briefly **SIX (6)** complications that possibly experiencing by Patient A after surgery.

(12 marks)

- (b) An artificial tooth of new composite metallic material was designed for replacing damaged tooth. However, this new tooth loosening after implant. Deduce problem arose and suggest **THREE (3)** strategies that will overcome this problem.

(8 marks)

**-END OF QUESTIONS -**

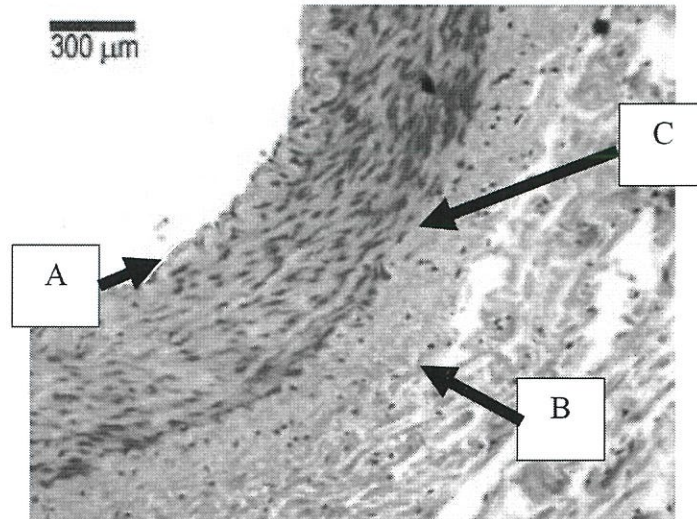
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**Figure Q1(a)**

**Table Q4**

Types of Materials	Specific name of biomaterials	Advantages	Characterization method	Examples
Polymer	(i)	(ii)	(iii)	(iv)
Metal	(v)	(vi)	(vii)	(viii)
Ceramic	(ix)	(x)	(xi)	(xii)
Composites	(xiii)	(xiv)	(xv)	(xvi)



**Figure Q5**

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