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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
(ONLINE)
SEMESTER II
SESSION 2020/2021**

COURSE NAME : MATERIALS TESTING
COURSE CODE : BDB 40203
PROGRAMME CODE : BDD
EXAMINATION DATE : JULY 2021
DURATION : 3 HOURS
INSTRUCTION : ANSWER **FIVE (5)** OUT OF SIX (6)
QUESTIONS

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

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- Q1**
- (a) Determine the fundamental procedure for materials testing. (2 marks)
 - (b) Radiation energy will affects its penetrating power. Illustrate the material under low and high energy of radiation. (2 marks)
 - (c) Evaluate the TWO (2) conditions of couplant in Ultrasonic Inspection. (4 marks)
 - (d) You are required to select a suitable material for the shaft of a steam turbine for a power generating plant. After screening out the materials, the most suitable candidates are shown in **Table Q1(d)**.
 - (i) Identify the possible failure mode of the shaft and therefore what is the main mechanical property requirement? (6 marks)
 - (ii) You need to choose one of the following material with full justification. (6 marks)

- Q2** You are in charge of the maintenance department of a commercial airline company. As part of regular inspection, you asked your materials engineer to check the landing gear and the jet engines turbine blades for AIRBUS 380 as shown in **Figure Q2**. The materials engineer reported to you that he had found the following issues with the landing gear and Semimonocoque fuselage structure of AIRBUS 380;

Landing gear.

NDT (Non-destructive testing) showed signs of very fine cracks just under the surface of the main shaft near the joint.

Fuselage structure:

Using visual inspection method, the engineer found bending and fatigue deformation at Fuselage structure.

- (i) What is your conclusion as to whether it is safe to continue the use of the aircraft and why? (the likely failure modes) (6 marks)
- (ii) If the landing gear fails, Evaluate are the main features of the fracture surface? (4 marks)

- (iii) For the Fuselage, examine the mechanisms which could be responsible for the failure mode. (4 marks)
- (iv) Form your observation what the suitable testing that can be done to further investigate for material using to produce Fuselage structure. Explain with full justification. (6 marks)
- Q3**
- (a) List TWO (2) different ways in which a specimen shows contrast in a reflected light microscope. (4 marks)
- (b) As a new Engineer in company Claytan Sdn. Bhd, you find out a lot of powders in your lab with having similar colour. What you can suggest the best method to be select for finding their properties and phases including a detail explanation of the method's principal. (8 marks)
- (c) A close-packed opal structure observed by a field emission scanning electron microscope (FESEM) at different accelerating voltages is shown in **Figure Q3(c)**. Distinguish the image of accelerating voltage of
- (i) 1 kV
 - (ii) 20 kV.
- (8 marks)
- Q4**
- (a) Explain THREE (3) limitations of X-ray diffraction (XRD). (6 marks)
- (b) These powders then were coated with organic treatment. However the previous method as in **Q3(a)** is no longer capable to evaluate the reaction of organic treatment. It is recommended to use Fourier Transform Infra Red (FTIR) for this purpose. Justify why the FTIR is more suitable method. (5 marks)
- (c) Illustrate the basic component in FTIR equipment. (5 marks)
- (d) Compare the general form of an X-ray diffraction pattern indicative of a material that is:
- (i) polycrystalline
 - (ii) amorphous
- (4 marks)

- Q5** (a) Describe the function of Differential Scanning Calorimetry (DSC). (4 marks)
- (b) Refer to the DSC plot of PET in Figure S5(b). Interpret the following phases:
- (i) Crystalization.
 - (ii) Glass Transition.
 - (iii) Melting. (6 marks)
- (c) If the material changes to the thermoset plastic, predict the different in DSC plot that possible to be observed? (4 marks)
- (d) Refer to the question Q5(c), show the possible sketch of DSC plot for this material. (6 marks)
- Q6** (a) Explain SIX (6) procedure in detail of the metallographic sample preparation. (6 marks)
- (b) Distinguish the major differences between Light Microscopy and Transmission Electron Microscopy (TEM). (4 marks)
- (c) Appraise the 'charging' phenomenon and the importance of conductive film coating on non-metallic specimen in the Scanning Electron Microscope (SEM) operation. (10 marks)

- END OF QUESTION -

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Table Q1 (d)

Property	Aluminium	Titanium	Magnesium	High-strength steel	Nickel superalloy	Carbon fibre composite
Cost	Cheap	Expensive	Medium	Medium	Expensive	Expensive
Weight (density)	Light	Medium	Very light	Heavy	Heavy	Very light
Stiffness (elastic modulus)	Low/medium	Medium	Low	Very high	Medium	High
Strength (yield stress)	Medium	Medium/high	Low	Very high	Medium	High
Fracture toughness	Medium	High	Low/medium	Low/medium	Medium	Low
Fatigue	Low/medium	High	Low	Medium/high	Medium	High
Corrosion resistance	Medium	High	Low	Low/medium	High	Very high
High-temperature creep strength	Low	Medium	Low	High	Very high	Low
Ease of recycling	High	Medium	Medium	High	Medium	Very low



Aluminium (61%)

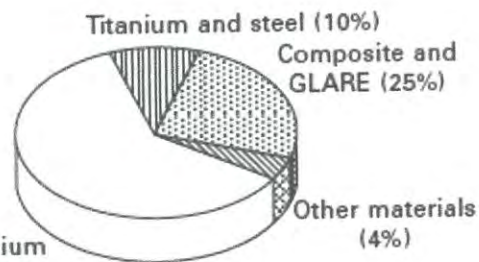


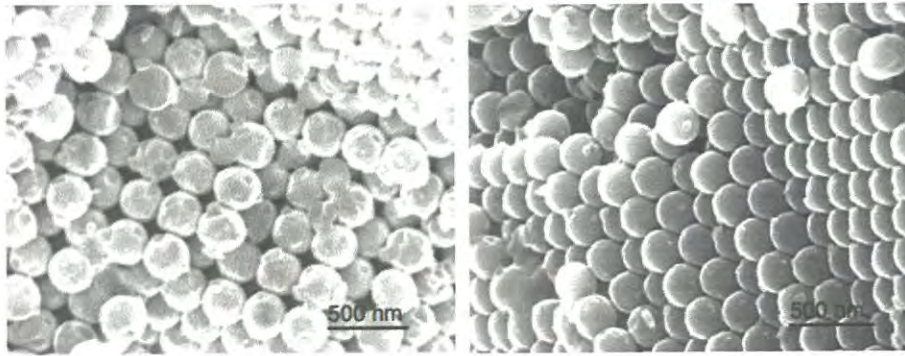
Figure Q2

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(i)

(ii)

Figure Q3 (c)

Sample: PET80PC20_MM1 1min
Size: 23.4300mg
Method: standard dsc heat/cool/heat
Comment: 5/4/06

DSC

File: C:\...DSCMelt Mixed1\PET80PC20_MM1.001
Operator: SAC
Run Date: 05-Apr-2006 15:34
Instrument: DSC Q1000 V9.4 Build 287

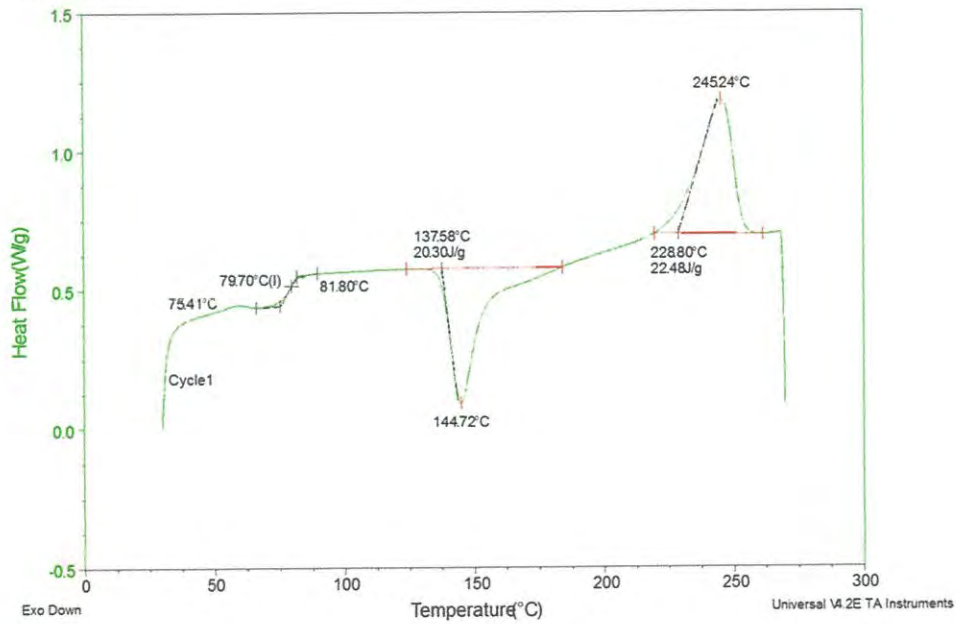


Figure Q5 (b)