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UNIVERSITI TUN HUSSEIN ONN MALAYSIA

**FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019**

COURSE NAME : MATERIAL TESTING
COURSE CODE : BDB 40203
PROGRAMME CODE : BDD
EXAMINATION DATE : JUNE/JULY 2019
DURATION : 3 HOURS
INSTRUCTION : ANSWER ONLY **FIVE (5)** QUESTIONS
FROM **SIX (6)** QUESTIONS PROVIDED

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

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- Q1** (a) Scanning Electron Microscope (SEM) is the most popular electron microscope. What is the main application of SEM?
(2 marks)
- (b) Sodium (Na)-doped calcium phosphate (CaP) was prepared through sol-gel synthesis. Choose one method with explanation to determine the percentage (%) of sodium (Na) in the prepared sample.
(4 marks)
- (c) Polishing process is used to remove all visible scratches from grinding. Differentiate between coarse polishing and fine polishing
(6 marks)
- (d) The image of particles shape for nano size Aluminum/Graphene composite was not clear when examined under SEM. Please justify this problem and suggest one suitable technique to get the clear image of the composites particles shape.
(8 marks)
- Q2** (a) Hardness is the resistance of material to permanent plastic deformation under a load. Describe the principle of hardness test.
(3 marks)
- (b) Several mechanical properties of a material can be obtained from a stress–strain curve. Sketch a stress-strain curve for stainless steel before and after heat treated at high temperature.
(5 marks)
- (c) The creep of material can be divided into three stages; primary, secondary and tertiary stages. Distinguish between secondary stage and tertiary stage in creep vs time in graph
(5 marks)
- (d) Creep is a deformation that occurs over a period of time when a material is subjected to constant stress at constant temperature. In your point of view, why creep test is important in automotive industry?
(7 marks)
- Q3** (a) Explain on how to analyze the graph obtained from Fourier Transform Infrared (FTIR) analysis.
(3 marks)
- (b) X-Ray Diffraction (XRD) is the most important methodology used in the characterization of materials. Write the Bragg's Law equation in background of diffraction
(4 marks)
- (c) Differentiate the applications between X-Ray Diffraction (XRD) analysis and X-ray Fluorescence (XRF) analysis.
(5 marks)

- (d) Alumina/Tricalcium Phosphate (Al/TCP) composite was prepared through milling process. How to determine the existence of TCP phase in the prepared composite and how to prepare the sample prior to the selected analysis method?
(8 marks)
- Q4** (a) **Figure Q4 (a)** shows the schematic Differential Scanning Calorimetric (DSC) curves for a polymeric sample. Discuss the phases exhibited in the schematic DSC curve.
(3 marks)
- (b) Thermogravimetric (TG) analysis is a technique for measuring mass change of a sample with temperature. Sketch TG curves that exhibit decomposition from starting temperature T_i to finish temperature T_f .
(4 marks)
- (c) Distinguish the working principle between Differential Scanning Calorimetric (DSC) and Differential Thermal Analysis (DTA).
(6 marks)
- (d) The rice husk reinforced PLA composites were fabricated by hand lay-up technique. Select one suitable method with description to analyze the modulus (E'), damping ($Tan \delta$) and glass transition temperature (T_g).
(7 marks)
- Q5** (a) Identify the applications of ultrasonic inspection in nondestructive testing.
(3 marks)
- (b) The NDT officer was assigned to inspect the concrete pipelines and pressure vessels. Choose one suitable NDT method with the limitations to be used in the inspection.
(4 marks)
- (c) What are the advantages of Radiographic Inspection compared to Liquid Penetrant Inspection?
(5 marks)
- (d) Why ceramic pressure vessel cannot be inspected by using Eddy Current testing? Write the principle of Eddy Current testing.
(8 marks)
- Q6** (a) Materials testing is performed for a variety of reasons and can provide a wealth of information about the tested materials, prototypes or product samples. Classify the types of thermal test and non-thermal test.
(3 marks)

- (b) Fatigue test generally require significant experimental effort and time, which implies that these tests are more expensive than simple tests of several other mechanical properties. Write the micro-mechanism of fatigue that leads to the fatigue failure.
(4 marks)
- (c) Information from ultrasonic testing can be presented in a number of differing formats. Three of the more common formats include A-scan, B-scan and C-scan. What are the different between the three formats?
(6 marks)
- (d) Aircraft engines are overhauled after being in service for a period of time. They are completely disassembled, cleaned, inspected and then reassembled. Based on your knowledge, select one technique with procedure to measure the defects or cracks on the aircraft engine.
(7 marks)

– END OF QUESTION –

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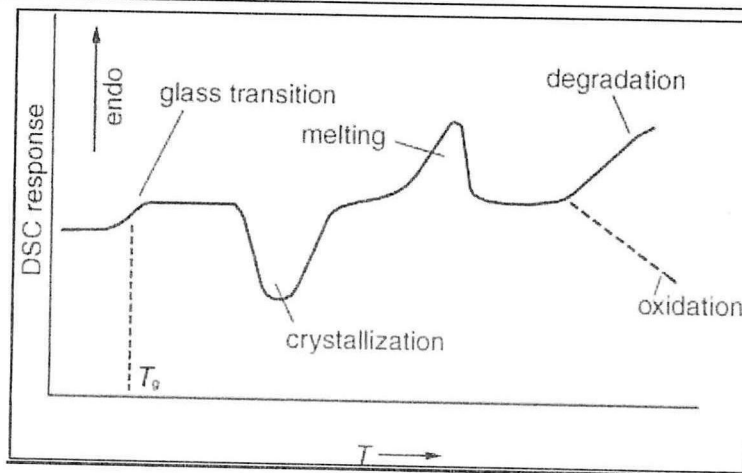


Figure Q4 (a)