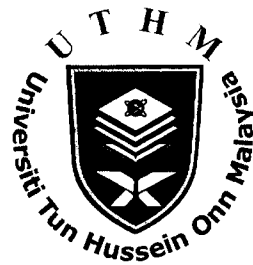


**CONFIDENTIAL**



**UNIVERSITI TUN HUSSEIN ONN MALAYSIA**

**FINAL EXAMINATION  
SEMESTER II  
SESSION 2012/2013**

COURSE NAME : ENGINEERING TECHNOLOGY  
MATERIALS

COURSE CODE : BDU 10603

PROGRAMME : 1&2 BDC / 1&2 BDM

EXAMINATION DATE : JUNE 2013

DURATION : 3 HOURS

INSTRUCTION : ANSWER FIVE (5) QUESTIONS ONLY

THIS QUESTION PAPER CONSISTS OF SIX (6) PAGES

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- Q1** (a) Metals, ceramics and polymers are main classification of materials. Choose TWO (2) materials and describe in terms of its bonding and properties.  
(8 marks)
- (b) Sketch with complete labels for the following planes and directions in cubic unit cell:  
(i)  $(\bar{1}\bar{2}2)$   
(ii)  $(\bar{3}\bar{1}\bar{2})$   
(iii)  $[\bar{1}12]$   
(iv)  $[201]$   
(8 marks)
- (c) Calculate the planar atomic density in the (101) plane for the  $\alpha$  iron BCC which has a lattice constant,  $a$  equal to 0.30 nm.  
(4 marks)
- Q2** (a) Outline THREE (3) types of mechanical test.  
(6 marks)
- (b) An aluminum plate of 5 mm thick is to withstand a force of 55 000 N with no permanent deformation. If the aluminum has a yield strength of 135 MPa, calculate the minimum suitable width of the plate?  
(8 marks)
- (c) Explain ONE (1) type of hardness test.  
(6 marks)

- Q3** (a) Illustrate ionic crystal defects; Frenkel defect and Schottky defect.  
(6 marks)
- (b) Sketch the concentration of diffusing species against position graph for steady-state diffusion.  
(6 marks)
- (c) Differentiate between inter-diffusion and self-diffusion.  
(4 marks)
- (d) A plate of iron is exposed to a carburizing (carbon-rich) atmosphere on one side and a decarburizing (carbon-deficient) atmosphere on the other side at 700°C (1300°F). If condition of steady state is achieved, calculate the diffusion flux of carbon through the plate if the concentrations of carbon at positions of 3 and 8 mm beneath the carburizing surface are 1.4 and 0.9 kg/m<sup>3</sup>, respectively. Assume the diffusion coefficient of  $3 \times 10^{-11}$  m<sup>2</sup>/s at this temperature.  
(4 marks)
- Q4** (a) By referring to Pb-Sn system in **Figure Q4**,
- (i) Identify the type of invariant reaction occurs and provide the related equations.  
(2 marks)
- (ii) Apply a phase analysis for Pb-Sn alloy with composition of 30-wt% Sn at 183 - ΔT °C.  
(12 marks)
- (b) Distinguish between phase diagram and TTT diagram.  
(3 marks)
- (c) Explain the full annealing and quenching process in heat treatment of steel.  
(3 marks)

- Q5** (a) Define the following type of materials.  
(i) Non Ferrous alloy  
(ii) Glass ceramics  
(2 marks)
- (b) Describe TWO (2) situations that casting techniques can be employed in fabrication of metals.  
(3 marks)
- (c) Choose ONE (1) suitable material for each of the following purpose with justifications:  
(i) Water pipe  
(ii) Floor tiles  
(12 marks)
- (d) Compare the properties of crystalline ceramics and glass ceramics.  
(3 marks)
- Q6** (a) Explain the function of matrix, interface and reinforcement in composite material.  
(3 marks)
- (b) Pultrusion, prepreg production processes and filament winding are techniques used to process fiber-reinforced composites. Briefly describe ONE (1) of the processes and cite the advantages and disadvantages of the process.  
(3 marks)
- (c) A continuous and aligned glass fiber-reinforced composite consists of 40 vol% of glass fibers having a modulus of elasticity of 69 GPa and 60 vol% of a polyester resin that, when hardened, displays a modulus of 3.4 GPa.  
(i) Compute the modulus of elasticity of this composite in the longitudinal direction.  
(ii) If the cross-sectional area is  $250 \text{ mm}^2$  and a stress of 50 MPa is applied in this longitudinal direction, calculate the magnitude of the load carried by each of the fiber and matrix phases.