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

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) $(1\bar{2}2)$

(ii) $(\bar{3}1\bar{2})$

(iii) $[\bar{1}12]$

(iv) [201]

(8 marks)

(c) Calculate the planar atomic density in the (101) plane for the α 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^3, respectively. Assume the diffusion coefficient of $3 \times 10^{-11} m^2/s$ 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 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.