UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2010/2011

COURSE NAME	:	ENGINEERING TECHNOLOGY MATERIALS
COURSE CODE	:	BDU 10603
PROGRAM	:	1 BDC
EXAMINATION DATE	:	APRIL / MAY 2011
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER FIVE (5) OF THE SIX (6) QUESTIONS.

THIS EXAMINATION PAPER CONSISTS OF SEVEN (7) PAGES OF PRINTED MATERIAL

Q1 a) Give **THREE (3)** main classifications of polymer materials. Briefly explain each type of the polymer to differentiate them.

(8 marks)

(b) Sketch the following planes and directions for cubic and hexagonal:

(i) $(3\bar{1}3)$
(ii) (201)
(iii) $[2\bar{1}2]$
(iv) $[304]$
(v) $(10\bar{1}1)$
(vi) $(\bar{1}2\bar{1}0)$

(12 marks)

Q2 (a) Rearrange the atomic packing values of the following according to increasing manner:

Body centered cubic, Simple cubic, Face centered cubic

(3 marks)

(b) Copper has the atomic radius, R= 0.1278 nm and theoretical volume density of 8.94 g/cm^3. The atomic mass of Cu is 63.54 g/mol. Determine whether it has a BCC or a FCC crystal structure (show the calculations for both BCC and FCC in order to determine the correct crystal structure).

(12 marks)

(c) Define the following terms:

(i) Crystal structure
(ii) Unit cell
(iii) Lattice point

(5 marks)

Q3 (a) A gear made of 1018 steel (0.18 wt % C) is to be gas-carburized at 927°C (1700°F). If the carburizing time is 7.5 hr, at what depth in millimeters will the carbon content be 0.40 wt %? Assume the carbon content at the surface of the gear is 1.20 wt %. D (C in ë iron) at 927°C = 1.28×10^{-11} m^2/s. Error function is given in **TABLE Q3(a)**.

(12 marks)

(b) Explain about Frenkel and Schottky imperfection in crystal by including the appropriate illustrations.

(6 marks)

(c) Give **ONE (1)** reason why the diffusion process in based center cubic (BCC) structure is faster compared to face center cubic (FCC) structure.

(2 marks)

Q4 (a) Consider the binary eutectic copper-silver phase diagram in **FIGURE Q4(a)**. Make phase analyses of an 85 wt% Ag–15 wt% Cu alloy at 800°C. In the phase analysis, include:

(i) the phases present
(ii) the chemical compositions of the phases
(iii) the amounts of each phase

(10 marks)

(b) If an alloy of 30 wt% Ni - 70 wt% Cu is slowly heated from 1100 °C, (see **FIGURE Q4(b)**)

(i) At what temperature does the first liquid phase form?
(ii) What is the composition of the first liquid phase to form?
(iii) At what temperature does the alloy completely melt?

(3 marks)

(c) Identify and name the invariant reaction occurred in **FIGURE Q4(c)**. Write the equation for this reaction. Determine its composition.

(3 marks)

(d) Define heat treatment. State **TWO (2)** types of heat treatments.

(4 marks)

Q5 (a) A composite consists of a continuous glass-fiber-reinforced-epoxy resin produced by using 60 percent by volume of E-glass fibers having a modulus of elasticity of 7.24×10^4 MPa and a tensile strength of 2.4 GPa; and a hardened epoxy resin with a modulus of 3.1×10^3 MPa and a tensile strength of 0.06 GPa. Assume the stress on the material causes uniform strain on all the composite layers.

(i) Calculate the modulus of elasticity of this composite
(ii) Calculate the tensile strength
(iii) If the cross-sectional area is 250 mm^2 and a stress of 50 MPa is applied, compute the magnitude of the load carried by each of fiber and matrix phases

(14 marks)

(b) Briefly explain why composite materials are widely used in an aircraft and list down **FOUR (4)** examples of aircraft parts which were made from composite materials.

(4 marks)

(c) Sheet molding is one example of the methods used to produce fiber-reinforced-plastics, particularly in automotive industry. List **TWO (2)** other processing methods to produce fiber-reinforced-plastics.

(2 marks)

Q6 (a) Give **TWO (2)** differences between intrinsic and extrinsic conduction.

(4 marks)

(b) A wire whose diameter is 0.20 cm must carry a 20 A current. The maximum power dissipation along the wire is 4 W/m. Calculate the minimum allowable electrical conductivity of the wire.

(5 marks)

(c) If a copper wire of commercial purity is to conduct 10 A of current with a maximum voltage drop of 0.4 V/m, what must be its minimum diameter?
Given that $\sigma = 5.85 \times 10^7 (\Omega.m)^{-1}$

(6 marks)

(d) List **THREE (3)** types of magnetism. Briefly explain any one of them.

(5 marks)

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TABLE Q3(a)

TABULATION OF ERROR FUNCTION

z	*erf(z)*	*z*	*erf(z)*	*z*	*erf(z)*
0	0	0.55	0.5633	1.3	0.9340
0.025	0.0282	0.60	0.6039	1.4	0.9253
0.5	0.0564	0.65	0.6420	1.5	0.9661
0.10	0.1125	0.70	0.6778	1.6	0.9763
0.15	0.1680	0.75	0.7112	1.7	0.9838
0.20	0.2227	0.80	0.7421	1.8	0.9891
0.25	0.2763	0.85	0.7707	1.9	0.9928
0.30	0.3286	0.90	0.7970	2.0	0.9953
0.35	0.3794	0.95	0.8209	2.2	0.9981
0.40	0.4284	1.0	0.8427	2.4	0.9993
0.45	0.4755	1.1	0.8802	2.6	0.9998
0.50	0.5205	1.2	0.9103	2.8	0.9999

EQUATION

$$J = -D\frac{dC}{dx}$$

$$\frac{C_x - C_o}{C_s - C_o} = 1 - \text{erf}\left(\frac{x}{2\sqrt{Dt}}\right)$$

$$D = D_o \exp\left(-\frac{Q_d}{RT}\right)$$

$$\ln D = \ln D_o - \frac{Q_d}{R}\left(\frac{1}{T}\right)$$

$$\log D = \log D_o - \frac{Q_d}{2.3R}\left(\frac{1}{T}\right)$$

$$P = iV = i^2 R$$

$$R = \rho\frac{l}{A}$$

$$F = \sigma A$$

$$F_c = F_f + F_m$$

$$\sigma = E\varepsilon$$

$$V_m = \frac{A_m}{A_c}$$

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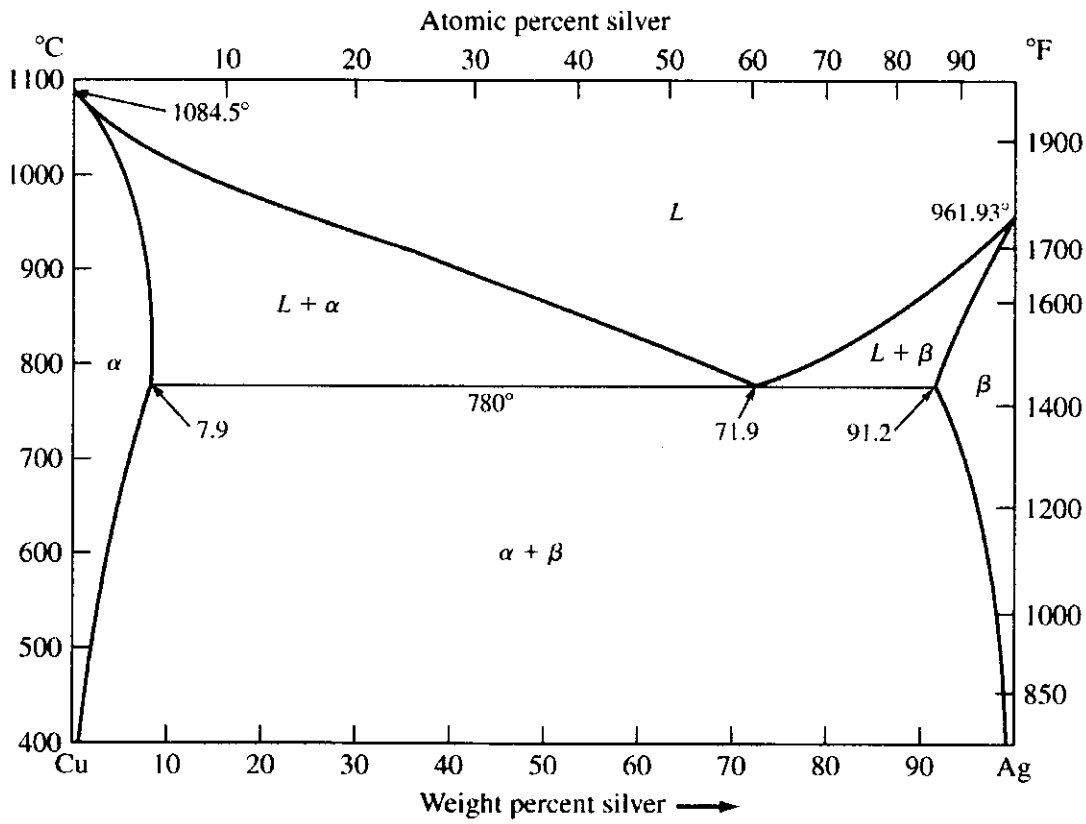

FIGURE Q4(a)

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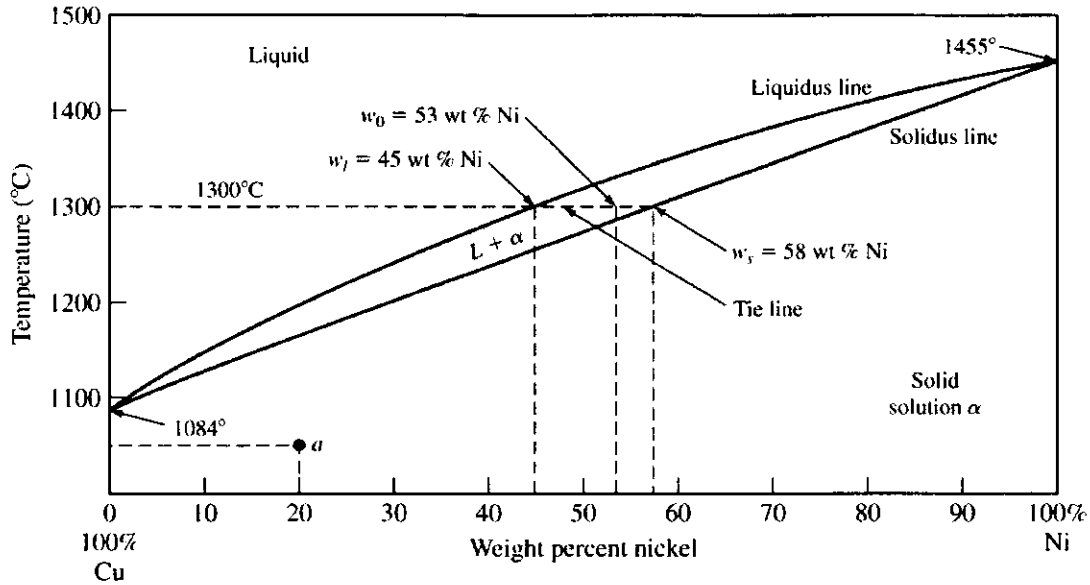

FIGURE Q4(b)

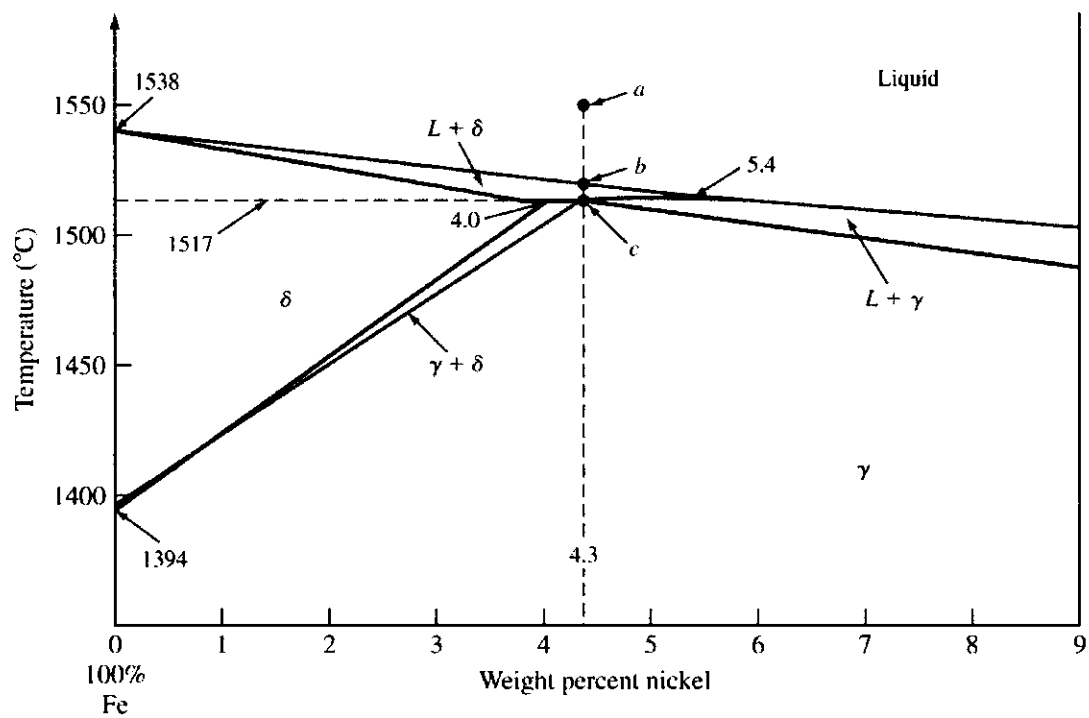

FIGURE Q4(c)