UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER I
SESSION 2012/2013

COURSE NAME	: MATERIALS SCIENCE
COURSE CODE	: BNR 10102
PROGRAMME	: BACHELOR OF INDUSTRIAL AUTOMATION ENGINEERING TECHNOLOGY (1 BND)
EXAMINATION DATE	: DECEMBER 2012 / JANUARY 2013
DURATION	: 3 HOURS
INSTRUCTION	: 1) ANSWER **FOUR (4)** OF SIX (6) QUESTIONS 2) **ONE (1)** QUESTION MUST BE ANSWERED FROM EACH SECTION 3) **TWO (2)** QUESTIONS MAY BE SELECTED FROM ANY SECTION

THIS QUESTION PAPER CONSISTS OF **EIGHT (8)** PAGES

SECTION A: Please answer **at least ONE (1)** question from this section.

Q1 (a) Explain the difference between types of materials and show these comparisons in terms of their main properties, bonding and structure.

(at least one comparison for every material)

(10 marks)

(b) Sketch with complete label for the following planes and directions in unit cubes:

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

(ii) (4 3 2)

(iii) $(\bar{2}\ 0\ 1)$

(iv) $[0\ 1\ \bar{1}]$

(v) [1 0 1]

(vi) $[1\ 2\ \bar{1}]$

(12 marks)

(c) Calculate the linear atomic density in the [110] direction for the α iron BCC which has a lattice constant, *a* equal to 0.30 nm.

(3 marks)

Q2 (a) Consider an alloy which is undergoing carburizing process, initially it has a uniform carbon concentration of 0.3 wt% and is to be treated at 950°C (1750°F). If the concentration of carbon at the surface is suddenly brought to and maintained at 1 wt%, how long it will take to achieve a carbon content of 0.80% at a position 0.4 mm below the surface? The diffusion coefficient for carbon in iron at this temperature is 1.6×10^{-11} m^2/s; assume that the steel piece is semi-finite. (use **Table Q2 (a)** to solve this question)

(15 marks)

(b) Differentiate between steady state and nonsteady state diffusion with an appropriate diagram.

(10 marks)

Q3 (a) Sketch a stress-strain diagram for a ductile metal. Indicate all the stated information in the sketch diagram:

(i) Stress axis

(ii) Strain axis

(iii) Maximum tensile stress

(iv) Elastic region

(v) Plastic region

(vi) Elastic (Young) Modulus

(10 marks)

(b) Consider an aluminium bar subjected to a load with 360 KPa. The initial diameter and after loading are measured and given as below.

Calculate:

Initial specimen diameter, $d_o = 0.050$ cm

Diameter of specimen under load, $d_i = 0.04$ cm

i) Engineering stress and strain

ii) True stress and true strain

(15 marks)

SECTION B: Please answer **at least ONE (1)** question from this section.

Q4 (a) **Figure Q4 (a)** is a copper-silver (Cu-Ag) phase diagram. By using the phase diagram solve the following;

(i) Phase composition at 600 °C and 50 wt% Ag

(ii) Propose the possible phases at point A, B and C

(15 marks)

(b) Differentiate between quenching and normalizing heat treatment in terms of the cooling procedure and the microstructure produced for steel.

(10 marks)

Q5 (a) Illustrate and explain the following stress-strain curves that are exposed to a uniaxial stress applied in the direction of alignment:

i) the brittle fiber,

ii) the ductile matrix materials

iii) an aligned fiber-reinforced composite

(12 marks)

(b) Explain **two (2)** types of polymer's molecular structure.

(6 marks)

(c) Slip casting and dry pressing are two examples of ceramics processing. Choose **one (1)** process, illustrate the process.

(7 marks)

Q6 (a) **Figure Q6 (a)** shows the specimen of aluminium oxide. Compare the optical properties of the specimen.

(6 marks)

(b) An aluminium wire 110 m long must experience a voltage drop of less than 1.7 V when a current of 3.5 A press through it. Compute the minimum diameter of wire if the electrical conductivity of aluminium is $3.8 \times 10^7 (\Omega.m)^{-1}$.

(10 marks)

(c) Explain the relationship between magnetic flux density and magnetic field using an equation.

(9 marks)

- END OF QUESTION -

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TABLE Q2 (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

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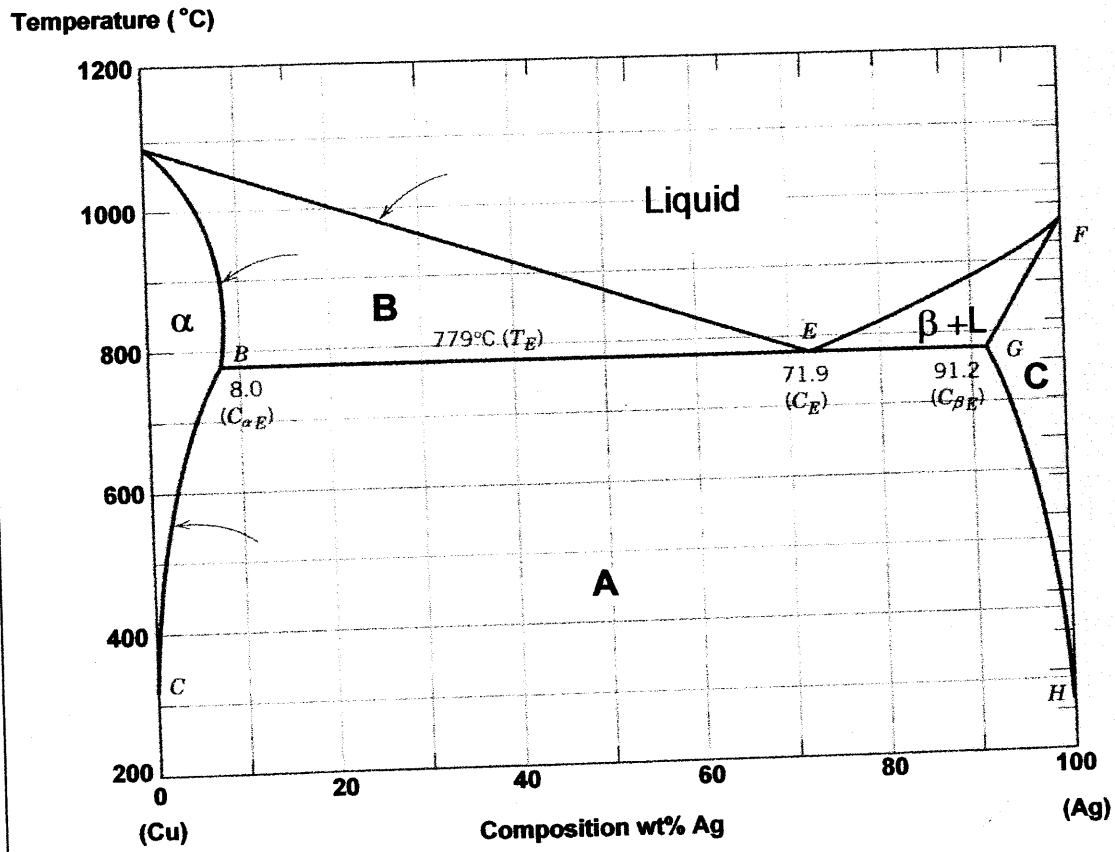

FIGURE Q4 (a)

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FIGURE Q6 (a)