UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESI 2016/2017

COURSE NAME	:	MATERIALS SCIENCE
COURSE CODE	:	DAM 20802
PROGRAMME CODE	:	DAM
EXAMINATION DATE	:	JUN 2017
DURATION	:	2 HOURS 30 MINUTES
INSTRUCTION	:	ANSWER **FOUR (4)** QUESTIONS ONLY

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

Q1 (a) Explain the importance of studying engineering material.

(4 marks)

(b) With suitable sketch, give explanation of ionic bond, covalent bond and metallic bonds

(6 marks)

(c) What is Atomic Packing factor? Show the Atomic Packing Factor (APF) of FCC Structure is 0.74.

(6 marks)

(d) Construct the direction from the indices direction given:

(i) $[1\ \ 1\ \ 1]$

(ii) $[0\ \ 1\ \ 2]$

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

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

(v) $[1\ \ \bar{1}\ \ 1]$

(5 marks)

(e) From the Miller indices given below, within a cubic unit cell, sketch the following lattice plane:

(i) $(\bar{1}\bar{1}0)$

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

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

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

(4 marks)

Q2 (a) Give definition and **two (2)** example (products) for following types of material:
(i) Smart material
(ii) Advance material

(5 marks)

(b) Mechanical properties are used to classify and identify material. Mechanical properties of materials determined by performing specific laboratory experiments. List **four (4)** common hardness test that can be done in laboratory.

(4 marks)

(c) Imperfection in solid can be describes into three which are point defect, line defect and bulk defect. Show the different between point defect for metal and ceramic.

(6 marks)

(d) Impurity point defects are found in solid solutions. There are tyo types of impurity point defect which are substitutional and interstitial. Discuss any **three (3)** factors that determine the degree of solvent dissolved in solid solution (Hume-Rothery Rules)

(6 marks)

(e) Diffusion is the phenomenon of material transport by atomic motion. There are two types of diffusion in solid which are inter-diffusion and self-diffusion. In order for diffusion to take place, there are two conditions that must be met. Explain these **two (2)** conditions.

(4 marks)

Q3 (a) Define invariant reactions below;
(i) Peritectic
(ii) Peritectoid
(iii) Eutectic
(iv) Eutectoid

(4 marks)

(b) What is **three (3)** important information that we could obtain from phase diagram?

(3 marks)

(c) **Figure 3(c)** showed the copper-silver alloy phase diagram. Named the item as label by:

Phase
i. A
ii. B
iii. C
iv. D
v. E
vi. F

Line
vii. G
viii. H
ix. I
x. J

(10 marks)

(d) **Figure 3(d)** showed the phase diagram of Cu-Ni. For point X, Y and Z, determine
i) Phase Present
ii) Phase Composition
iii) Phase Amounts

(8 marks)

Q4 (a) What are the purposes of heat treatments?

(2 Marks)

(b) Describe the following heat treatment procedures for steels and, for each, the intended final microstructure
(i) Annealing
(ii) Normalizing
(iii) Tempering

(6 Marks)

(c) Discuss the mechanical properties of the following microstructure:
(i) Fine Pearlite
(ii) Coarse Pearlite
(iii) Martensite
(iv) Bainite

(8 Marks)

(d) Stainless steel is a class of high alloy steels where major alloying element is chromium. Describe **two (2)** mechanical properties of stainless steel and **three (3)** major applications of stainless steel.

(5 Marks)

(e) Titanium is one non-ferrous material. Describe **two (2)** mechanical properties of titanium and **two (2)** major applications of titanium.

(4 Marks)

Q5 (a) Briefly explain electrochemical corrosion and cite two locations where corrosion normally started.

(2 marks)

(b) Galvanic series represents the relative reactivities of a number of metals and commercial alloys in seawater. List **two (2)** top cathodic material and **three (3)** most anodic material in galvanic series.

(5 marks)

(c) Briefly explain the following types of corrosion.

(i) Uniform Attack – General Corrosion
(ii) Galvanic Corrosion
(iii) Crevice Corrosion
(iv) Pitting
(v) Intergranular Corrosion

(10 marks)

(d) Discuss **four (4)** steps to controlled or prevent corrosion in a metal.

(8 marks)

- END OF QUESTION -

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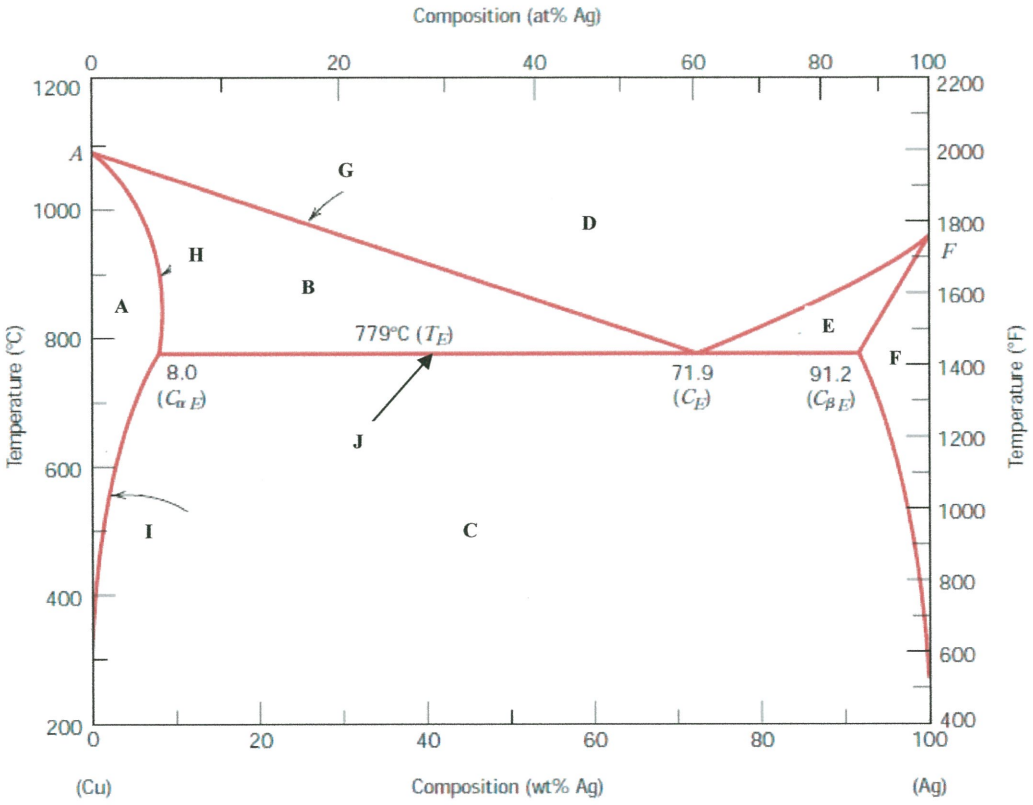

Figure 3(c)

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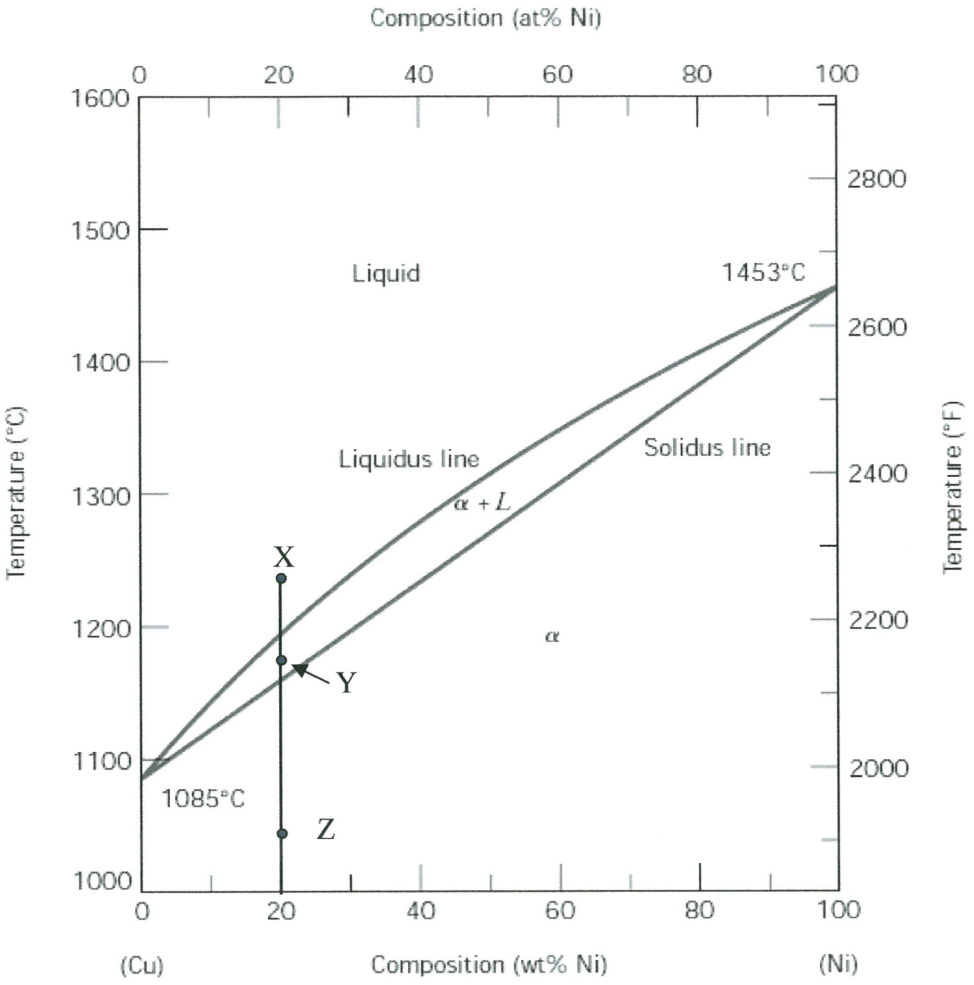

Figure 3(d)