INTI International University & Colleges

FINAL
ALTERNATIVE ASSESSMENT

(COVER PAGE)

Session	:	**April 2021**
Programme	:	Diploma in Mechanical Engineering (DMEN) Diploma in Electrical & Electronic Engineering (DEEI)
Course	:	**EGM1184: Structures and Properties of Materials** **EGM1185: Materials Science**
Date of Examination	:	26 July 2021 (Monday)
Time	:	8.00am – 10.15am Reading Time : Nil
Duration	:	2 Hours 15 Minutes

Special Instructions :

This paper consists of **FOUR (4)** questions. Answer all **FOUR (4)** questions.

Material permitted :
Non-Programmable Scientific Calculator

Materials provided :
Periodic Table

Examiner(s)	:	**Johnny Wong Kee Hui**
Chief Moderator	:	Iylia Elena Abdul Jamil

This paper consists of 7 printed pages, including the cover page

DIPLOMA IN ELECTRICAL & ELECTRONICS ENGINEERING PROGRAMME (DEEI)
DIPLOMA IN MECHANICAL ENGINEERING PROGRAMME (DMEN)
EGM1185: MATERIALS SCIENCE
EGM1184: STRUCTURE AND PROPERTIES OF MATERIALS
FINAL ALTERNATIVE ASSESSMENT: APRIL 2021 SESSION

Instructions: This paper consists of **FOUR (4)** questions. Answer all **FOUR (4)** questions.

Question 1

a. Find the chemical formula of an intermetallic compound that consists of 37 wt % Ti and 63 wt % Al.

(7 marks)

b. Copper is added to silver to create sterling silver, which is stronger and more durable. The amount of copper added is 7.5 wt %. A sterling silver spoon has a mass of 100 grams. Find the number of copper and silver atoms in the spoon.

(7 marks)

c. Illustrate in a unit cube a crystal plane that has Miller index of $[3\ \bar{2}\ 1]$, together with the intercepts at the x, y and z planes.

(5 marks)

d. Describe and illustrate the following types of defects that can be present in a metal.
   a. Vacancy

   (3 marks)

   b. Interstitially

   (3 marks)

Question 2

a. The temperature of 1 kg of the alloy shown in Figure Q2(a) is lowered slowly until the liquid-solution composition is 18 wt % B and the solid-solution composition is 66 wt % B. Find the amount of each phase in grams.

(6 marks)

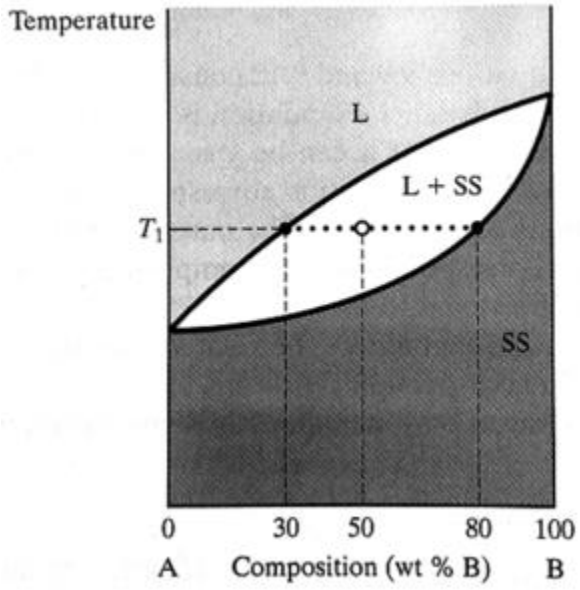

Figure Q2(a)

b. For 1 kg of eutectoid steel at room temperature, find the amount of each phase (α and Fe_3C) present. Refer to the diagram shown in Figure Q2(b).

(6 marks)

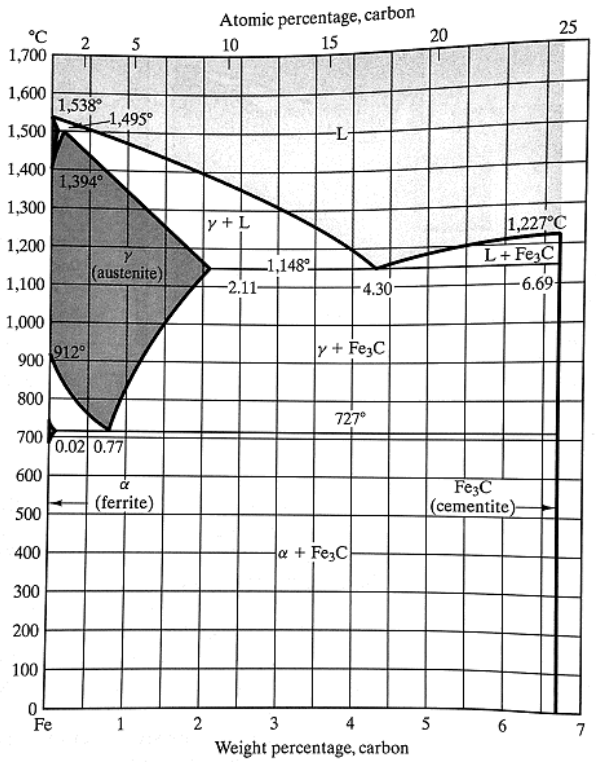

Figure Q2(b)

c. From Figure Q2(c), find:

i. the solubility of tin in solid lead (Pb) at 100°C. (2 marks)

ii. the maximum solubility of lead (Pb) in solid tin (Sn). (2 marks)

iii. the amount of β that forms if a 90% Pb - 10% Sn alloy is cooled to 0°C. (3 marks)

iv. the mass of tin contained in the α and β phases. (3 marks)

v. the mass of lead contained in the α and β phases. (3 marks)

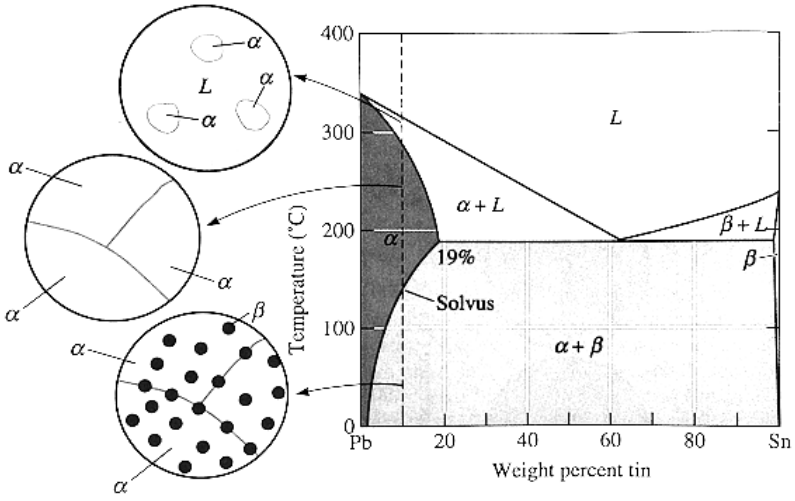

Figure Q2(c)

Question 3

a. Distinguish between natural aging and artificial aging for a precipitation metal hardening. (4 marks)

b. Define the following terms related to the mechanical behavior of materials

i. Endurance limits, (2 marks)

ii. Fatigue strength, (2 marks)

iii. Engineering stress and its SI unit, (2 marks)

iv. Engineering strain and its SI unit. (2 marks)

c. A 20-cm-long rod with a diameter of 0.250 cm is loaded with a 5000 N weight. If the diameter decreases to 0.210 cm, find the following:

i. The engineering stress at this load. (3 marks)

ii. The engineering strain at this load. (3 marks)

iii. The true stress at this load. (2 marks)

iv. The true strain at this load. (3 marks)

d. Define the hardness of a metal. (2 marks)

Question 4

a. The electrical conductivity of several materials is shown in Table Q4(a). Justify which material will be more suitable if an electrical transmission line 1500 m long that will carry a current of 50 A with no more than 5 x 10^5 W loss in power is needed.

(8 marks)

Table Q4(a)

	σ (ohm^{-1} · cm^{-1})	A (cm^2)	Diameter (cm)
Aluminum	3.77×10^5	0.00199	0.050
Copper	5.98×10^5	0.00125	0.040
Silver	6.80×10^5	0.00110	0.037

b. Write down the equation for the following laws, and define the symbols in each of the equation and indicate their SI units.

i. Macroscopic forms of Ohm's Law

(3 marks)

ii. microscopic forms of Ohm's law.

(3 marks)

c. If there are 400 grains per square inch on a photomicrograph of a ceramic material at 200x magnification, find its ASTM grain-size number.

(5 marks)

d. Find the radius of the largest interstitial void in the FCC γ iron lattice. The atomic radius of the iron atom in this lattice is 0.129 nm, and the largest interstitial voids occur at the position of (0, 1/2, 0).

(6 marks)

~THE END~

PERIODIC TABLE OF ELEMENTS