INTI
International College Penang
LAUREATE INTERNATIONAL UNIVERSITIES

FINAL
Examination Paper

(COVER PAGE)

Session	:	August 2015
Programmes	:	Diploma in Electrical and Electronic Engineering (DEEI)
Course	:	**EGM 1182: Structures and Properties of Material**
Date of Examination	:	9th December 2015 (Wednesday)
Time	:	8:00am – 10:00am Reading Time: Nil
Duration	:	2 Hours
Special Instructions	:	

This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

IMPORTANT NOTE : THIS PAPER SHOULD NOT BE TAKEN OUT OF THE EXAMINATION HALL

Materials permitted :

Non-Programmable Scientific Calculator

Materials provided:

Nil

Examiner(s)	:	**Mr. Phua Chin Lai**
Moderator	:	Prof. Dr. Cheong Kuan Yew

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

INTI INTERNATIONAL COLLEGE PENANG

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING PROGRAMME (DEEI)
EGM 1182: STRUCTURES AND PROPERTIES OF MATERIAL
FINAL EXAMINATION : AUG 2015 SESSION

Instructions: This paper consists of **SIX (6)** questions. Answer any **FOUR (4)** questions in the answer booklet provided. All questions carry equal marks.

Question 1

(a) Briefly describe the following types of secondary bonding:
(i) fluctuating dipole, and
(ii) permanent dipole.

(5 marks)

(b) Write the electron configurations of the following elements and ion by using *spdf* notation:
(i) potassium,
(ii) Ni^{2+}

(6 marks)

(c) What is the chemical formula of an intermetallic compound that consists of 15.68 wt % Mg and 84.32 wt % Al?

(8 marks)

(d) Describe the ionic bonding process between a pair of Na and Cl atoms. Which electrons are involved in the bonding process?

(6 marks)

Question 2

(a) Cadmium at 20°C has a HCP structure with atoms of radius of 0.148 nm. Calculate the volume of unit cell of cadmium. Assume that the atomic packing factor for HCP crystal structure is 0.74.

(5 marks)

(b) A metal wire 1 mm in diameter with 10 m long carries a current of 0.1 A. if the metal is pure copper at 30°C, what is the voltage drop along this wire.
(Given the metal resistivity at 20°C , ρ_e = 17.24 x 10^{-7} Ω .cm, and coefficient of resistivity, α = 0.0039 $^{\circ}C^{-1}$)

(8 marks)

(c) From the relationship of length, a and the atomic radius, R of a face-centered unit cell (FCC), calculate the radius of an iridium atom in nm. Given that Ir has a FCC crystal structure, a volume density of 22.4 g/cm^3, and an atomic weight of 192.2 g/mol.

(6 marks)

(d) What fraction of conductivity of intrinsic silicon at room temperature is due to
(i) electrons and,
(ii) holes?
(Given the electron mobility $\mu_e = 0.140\ m^2/(\mathrm{V.s})$ and hole mobility $\mu_{\bar{h}} = 0.038\ m^2/(\mathrm{V.s})$ at room temperature)

(6 marks)

Question 3

(a) Draw in unit cubes the crystal planes that have the following Miller indices:
(i) $(3\ \bar{2}\ 1)$
(ii) $(\bar{2}\ 1\ \bar{2})$

(6 marks)

(b) Sketch the following direction vectors within a cubic unit cell.
(i) $[1\ \bar{1}\ \bar{1}]$
(ii) $[1\ \bar{1}\ 0]$
(iii) $[\bar{1}\ 2\ \bar{1}]$

(6 marks)

(c) Describe and illustrate the following imperfections that can exist in crystal lattices:
(i) Frenkel imperfection, and
(ii) Schottky imperfection.

(6 marks)

(d) Describe and illustrate with the aid of sketches, the solidification process of a pure metal in terms of the nucleation and growth of crystals.

(7 marks)

Question 4

(a) Distinguish between homogeneous and heterogeneous nucleation for the solidification of a metal.

(4 marks)

(b) Describe edge-type dislocations and screw-type dislocations. What type of strain fields surround both types of dislocations? Suitable diagrams must be used to assist your illustrations.

(9 marks)

(c) If 500 g of a 40 wt % Ag–60 wt % Cu alloy is slowly cooled from 1000°C to just below 780°C (refer to Figure 4 (a)):

(i) How many grams of liquid and proeutectic alpha are present at 850°C?
(ii) How many grams of liquid and proeutectic alpha are present at 780°C + ΔT?
(iii) How many grams of alpha are present in the eutectic structure at 780°C - ΔT?
(iv) How many grams of beta are present in the eutectic structure at 780°C - ΔT?

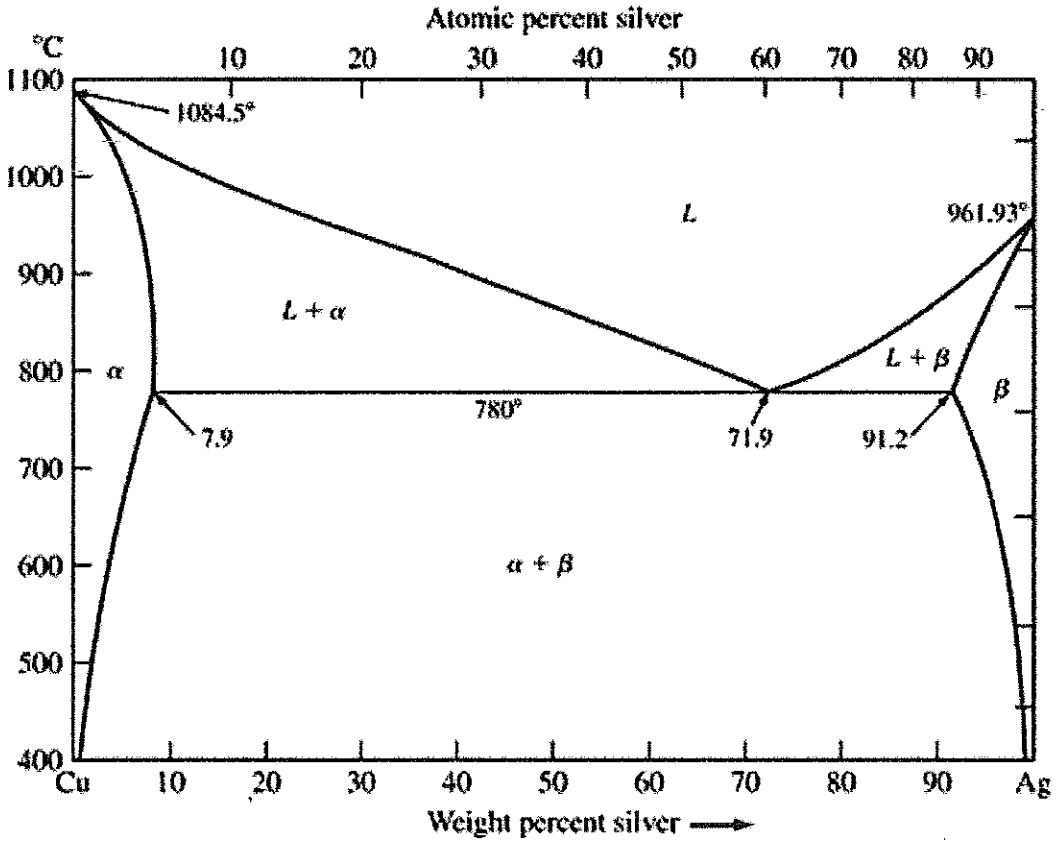

Figure 4 (a)

(12 marks)

Question 5

(a) Distinguish between traditional ceramic and engineering ceramic materials and for each type of ceramic, gives TWO (2) examples.

(6 marks)

(b) For a ceramic compound, what are the two characteristics of the component ions that determine the crystal structure?

(4 marks)

(c) Refer to Figure 5 (a). Define the following phases that exist in the Fe-Fe_3C phase diagram:
(i) austenite,
(ii) α ferrite,
(iii) cementite,
(iv) δ ferrite.
(Hint: you may want to state the maximum solid solubility of carbon in each phase above)

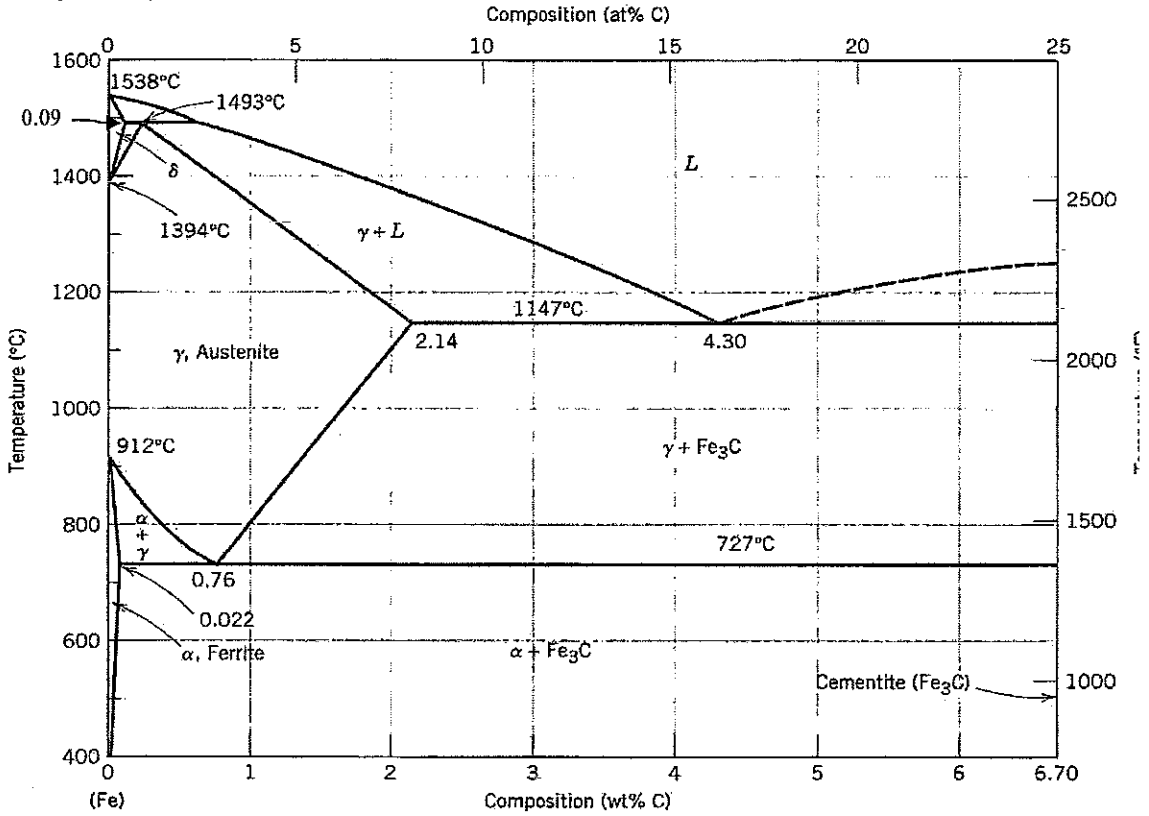

Figure 5 (a)

(12 marks)

(d) Write the Ohm's law equations for the
(i) macroscopic form and
(ii) microscopic form.

Define the symbols in each of the equations and indicate their SI units.

(3 marks)

Question 6

(a) A 15mm diameter aluminum alloy test bar is subjected to a load of 100 kN. If the diameter of the bar is 12 mm at this load, determine
(i) the engineering stress and engineering strain and
(ii) the true stress and true strain.

(9 marks)

(b) Explain the difference of characteristics between thermoplastic and thermosetting plastics.
(4 marks)

(c) Sketch the 'mer' structure of the following polymers:
(i) Polyethylene
(ii) Polyvinyl fluoride

(4 marks)

(d) Explain, using an energy-band diagram, how electrons and holes are created in pairs in an intrinsic silicon.

(8 marks)

--THE END--

EGM 1182(F)

APPENDIX 1

PERIODIC TABLE

																	2 He 4·003 Helium
			1 H 1·008 Hydrogen									5 B 10·81 Boron	6 C 12·01 Carbon	7 N 14·01 Nitrogen	8 O 16·00 Oxygen	9 F 19·00 Fluorine	10 Ne 20·18 Neon
3 Li 6·941 Lithium	4 Be 9·012 Beryllium											13 Al 26·98 Aluminium	14 Si 28·09 Silicon	15 P 30·97 Phosphorus	16 S 32·07 Sulfur	17 Cl 35·45 Chlorine	18 Ar 39·95 Argon
11 Na 22·99 Sodium	12 Mg 24·31 Magnesium																
19 K 39·10 Potassium	20 Ca 40·08 Calcium	21 Sc 44·96 Scandium	22 Ti 47·88 Titanium	23 V 50·94 Vanadium	24 Cr 52·00 Chromium	25 Mn 54·94 Manganese	26 Fe 55·85 Iron	27 Co 58·93 Cobalt	28 Ni 58·69 Nickel	29 Cu 63·55 Copper	30 Zn 65·39 Zinc	31 Ga 69·72 Gallium	32 Ge 72·59 Germanium	33 As 74·92 Arsenic	34 Se 78·96 Selenium	35 Br 79·90 Bromine	36 Kr 83·80 Krypton
37 Rb 85·47 Rubidium	38 Sr 87·62 Strontium	39 Y 88·91 Yttrium	40 Zr 91·22 Zirconium	41 Nb 92·91 Niobium	42 Mo 95·94 Molybdenum	43 Tc 98·91 Technetium	44 Ru 101·1 Ruthenium	45 Rh 102·9 Rhodium	46 Pd 106·4 Palladium	47 Ag 107·9 Silver	48 Cd 112·4 Cadmium	49 In 114·8 Indium	50 Sn 118·7 Tin	51 Sb 121·8 Antimony	52 Te 127·6 Tellurium	53 I 126·9 Iodine	54 Xe 131·3 Xenon
55 Cs 132·9 Cesium	56 Ba 137·3 Barium	57 La 138·9 Lanthanum	72 Hf 178·5 Hafnium	73 Ta 180·9 Tantalum	74 W 183·9 Tungsten	75 Re 186·2 Rhenium	76 Os 190·2 Osmium	77 Ir 192·2 Iridium	78 Pt 195·1 Platinum	79 Au 197·0 Gold	80 Hg 200·6 Mercury	81 Tl 204·4 Thallium	82 Pb 207·2 Lead	83 Bi 209·0 Bismuth	84 Po — Polonium	85 At — Astatine	86 Rn — Radon
87 Fr — Francium	88 Ra 226·0 Radium	89 Ac — Actinium	104	105	106												

KEY

Atomic Number 79 Au Symbol of element
Atomic Mass 197·0 Gold Name of element

58 Ce 140·1 Cerium	59 Pr 140·9 Praseodymium	60 Nd 144·2 Neodymium	61 Pm — Promethium	62 Sm 150·4 Samarium	63 Eu 152·0 Europium	64 Gd 157·3 Gadolinium	65 Tb 158·9 Terbium	66 Dy 162·5 Dysprosium	67 Ho 164·9 Holmium	68 Er 167·3 Erbium	69 Tm 168·9 Thulium	70 Yb 173·0 Ytterbium	71 Lu 175·0 Lutetium
90 Th 232·0 Thorium	91 Pa 231·0 Protactinium	92 U 238·0 Uranium	93 Np 237·0 Neptunium	94 Pu — Plutonium	95 Am — Americium	96 Cm — Curium	97 Bk — Berkelium	98 Cf — Californium	99 Es — Einsteinium	100 Fm — Fermium	101 Md — Mendelevium	102 No — Nobelium	103 Lr — Lawrencium

This sheet may be REMOVED for your convenience.