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FINAL
Examination Paper

(COVER PAGE)

Session	:	**January 2016**
Programme	:	Diploma in Electrical and Electronic Engineering (DEEI)
Course	:	**EGM 1182: Structures and Properties of Material**
Date of Examination	:	8 March 2016 (Tuesday)
Time	:	11:00am – 1:00pm
Duration	:	2 Hours Reading Time : Nil
Special Instructions	:	

This paper consists of **SIX (6)** questions. Attempt 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 :
Nil

Materials Provided :
Answer Booklet

Examiner(s) : **Mr. Phua Chin Lai**

Moderator : Prof. Ir. Dr. Cheong Kuan Yew

This paper consists of 5 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: JAN 2016 SESSION

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

Question 1

(a) All of the noble gases except helium have similar outer electron configuration. List down this similarity of outer electron configuration.

(2 marks)

(b) Briefly describe the following types of secondary bonding:
(i) fluctuating dipole,
(ii) permanent dipole and
(iii) between of the choice of noble gases krypton and xenon, which noble gas would be expected to have the strongest dipole bonding and why?

(9 marks)

(c) A monel alloy consists of 70 wt % Ni and 30 wt % Cu. What are the atom percentages of Ni and Cu in this alloy?

(9 marks)

(d) Zinc at 20°C has a hexagonal close packed (HCP) structure with atoms of diameter of 0.238 nm. Calculate the volume of unit cell of zinc. Assume that the atomic packing factor for HCP crystal structure is 0.74

(5 marks)

Question 2

(a) What are the two (2) main items of information that could be obtained from the Periodic Table of Elements?

(2 marks)

(b) Determine indices for the planes in the cubic unit cell shown in Figure 2.

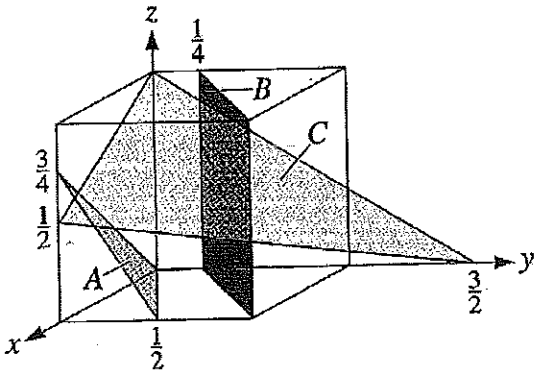

Figure 2.

(8 marks)

(c) Calculate the planar atomic density in atoms per square millimeter for the following crystal planes in a chromium BCC structure, which has a lattice constant of 0.28846 nm:
(*i*) (100), (*ii*) (110)

(9 marks)

(d) Describe and illustrate the solidification process of a pure metal crystal.

(6 marks)

Question 3

(a) In the solidification of a metal, what is the difference between an embryo and a nucleus? What is the critical radius of a solidifying particle?

(6 marks)

(b) Calculate the radius of the largest interstitial void in the BCC α iron lattice. The atomic radius of the iron atom in this lattice is 0.124 nm, and the largest interstitial voids occur at the position of (¼, ½, 0); (½, ¾, 0); (¾, ½, 0); (½, ¼, 0), etc.

(7 marks)

(c) Define the following terms related to the mechanical behavior of materials
(i) Endurance limits,
(ii) Fatigue strength,
(iii) Engineering stress and its SI unit,
(iv) Engineering strain and its SI unit.

(8 marks)

(d) Calculate the engineering stress in SI units on a 15-cm long bar with a cross section of 4.25 mm × 12.0 mm and subjected to a load of 5000 kg.

(4 marks)

Question 4

(a) What are the characteristics of a fracture surface in a ductile metal? (3 marks)

(b) What are the characteristics of a fracture surface in a brittle metal? (3 marks)

(c) What is metal creep? (3 marks)

(d) Phase diagram of an 88 wt% Al-12 wt% Mg alloy is shown in Figure 4. During solidification, determine
(i) the composition of first solid to be formed,

(ii) the amounts and compositions of each phase at 525 °C,

(iii) the amounts and compositions of each phase at 450 °C,

(iv) the amounts and compositions of each phase at 25 °C.

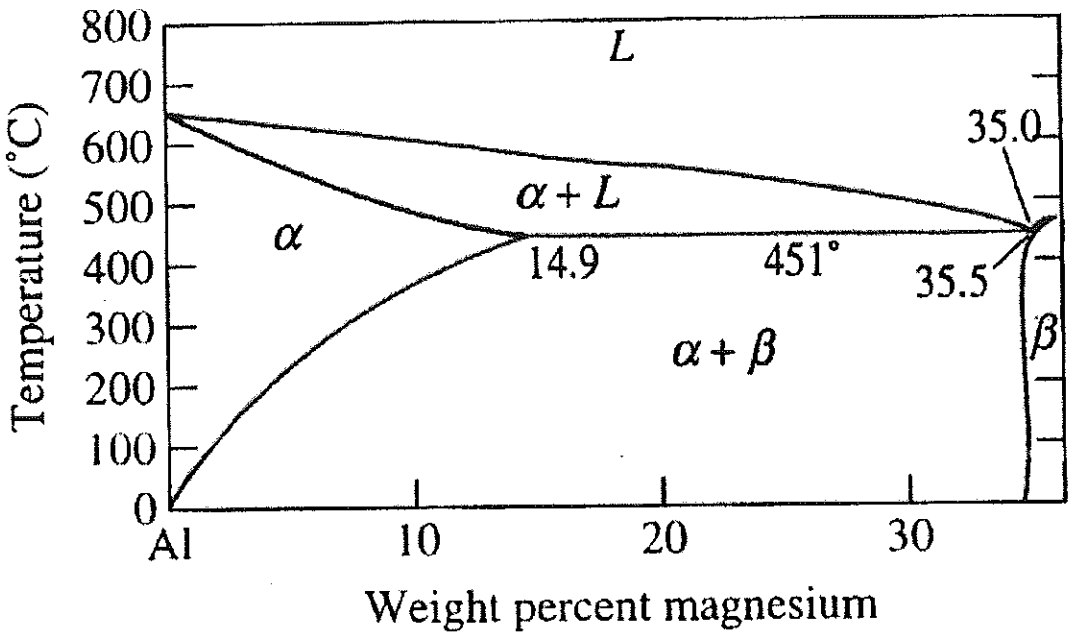

Figure 4

(16 marks)

Question 5

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

(4 marks)

(b) A high molecular weight polyethylene $-(C_2H_4)_n-$ has an average molecular weight of 410,000 g/mol. What is its average degree of polymerization?

(5 marks)

(c) Distinguish between a homopolymer and a copolymer.

(2 marks)

(d) Illustrate the following types of copolymers by using filled and open circles for their mers:
(i) random,
(ii) alternating,
(iii) block, and
(iv) graft.

(8 marks)

(e) List 6 mechanical properties of ceramic materials?

(6 marks)

Question 6

(a) Calculate the density in grams per cubic centimeter of CsBr, which complies to the lattice constant relationship equation $a\sqrt{3} = 2(r + R)$, where a is the lattice constant and ionic radii are represented by r and R. Given the unit cell of CsBr contains one Cs^+ and one Br^- ion. Ionic radii are Cs^+ =0.165 nm and Br^- = 0.196 nm.

(5 marks)

(b) Write equations for the
(i) macroscopic and
(ii) microscopic forms of Ohm's law.
Define the symbols in each of the equations and indicate their SI units.

(6 marks)

(c) Phosphorus is added to make an n-type silicon semiconductor with an electrical conductivity of 250 $\Omega \cdot m^{-1}$. Calculate the necessary number of charge carriers required.

(Assuming an electron mobility of $\mu_n = 0.1350\ m^2/(V.s)$, and absolute value of electron or hole charge is $1.6\times10^{-19}C$)

(5 marks)

(d) Twenty-cm-long rod with a diameter of 0.250 cm is loaded with a 5000 N weight. If the diameter decreases to 0.210cm, determine
(i) the engineering strain at this load and
(ii) the true stress and strain at this load.

(9 marks)

--THE END—

EGM 1182(F)Jan 16/CL PHUA

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 — Symbol of element

Atomic Mass — Au 197·0 — 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

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