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INTERNATIONAL COLLEGE PENANG (507232-U)
LAUREATE INTERNATIONAL UNIVERSITIES

FINAL
Examination Paper

(COVER PAGE)

Session	:	January 2012
Programme	:	Diploma in Electrical and Electronic Engineering Programme
Course	:	**EGM1182 : Structures and Properties of Materials**
Date of Examination	:	6 March 2012
Time	:	11a.m. – 1p.m 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.

Materials permitted : Nil

Materials provided : Periodic Table

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

Moderator : **Johnny Wong**

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 MATERIALS
FINAL EXAMINATION: JANUARY 2012 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) A gold wire is 0.70 mm in diameter and 8.0 cm in length. How many atoms does it contain? The density of gold is 19.3 g/cm^3.

(5 marks)

(b) Write the electron configuration of the following ions by using *spdf* notation:

(i) Cr
(ii) Cr^{2+}
(iii) Cr^{3+}

(6 marks)

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

(5 marks)

(a) Draw in unit cubes the crystal planes that have the following Miller indices:

(i) $(10\bar{2})$
(ii) $(3\bar{2}1)$
(iii) $(1\,\bar{1}\,\bar{1})$

(9 marks)

Question 2

(a) Calculate the linear atomic density in atoms per millimeter for the following directions in FCC iridium, which has a lattice constant of 0.38389 nm:

(*i*) [100],
(*ii*) [110],
(*iii*) [111].

(9 marks)

(b) When a cold-worked metal is heated into the temperature range where recovery takes place, how are the following affected:
(*i*) strength,
(*ii*) ductility, and
(*iii*) hardness?

(6 marks)

(c) Draw a typical creep curve for a metal under constant load and at a relatively high temperature, and indicate on it all three stages of creep.

(6 marks)

(d) What are the ceramic materials? List two importance properties of ceramic material that make them indispensible for many engineering design.

(4 marks)

Question 3

(a) Define a thermoplastic polymer.

(4 marks)

(b) How does the amount of crystallinity in a thermoplastic affect (i) its density and (ii) its tensile strength? Explain.

(6 marks)

(c) If a particular type of polyvinyl chloride (PVC) has a molecular mass of 250,000 g/mol, what is the degree of polymerization (DP)? Given the repeating chemical structural unit $-[CH_2\text{-}CHCl-]_n-$ (4 marks)

(d) Given the resistivity of copper at 0°C is $1.67\times10^{-6}\,\Omega.cm$ and its temperature resistivity coefficient is 0.0068 $(°C)^{-1}$, Calculate the electrical conductivity of pure copper at

(i) 400°C

(ii) -100°C

Comment on your results obtained in terms of effect of temperature on conductivity of copper.

(11 marks)

Question 4

(a) A copper wire is 3mm in diameter and 2m long. The electrical conductivity of copper is $6.0 \times 10^7\ (\Omega.m)^{-1}$.

(i) Compute the resistance of copper wire?

(ii) What would be the current flow if the potential drop across the ends of the wire is 0.05V?

(iii) What is the current density?

(iv) What is the magnitude of the electric field across the ends of wire? (10 marks)

(b) Describe briefly the following terms as pertaining to semiconducting materials:

(i) Acceptor level

(ii) Donor level (6 marks)

(c) Consider an alloy containing 70 wt % Ni and 30 wt % Cu (Figure 4d). At 1350°C make a phase analysis assuming equilibrium conditions. In the phase analysis include the following:

(i) What phases are present?

(ii) What is the chemical composition of each phase?

(iii) What amount of each phase is present?

(9 marks)

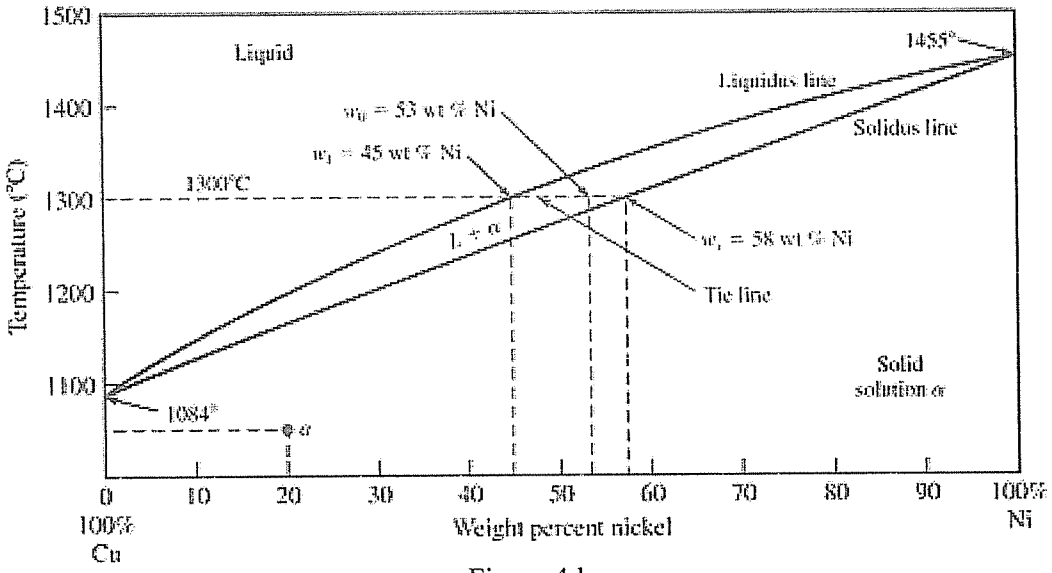


Figure 4d

Question 5

(a) Define the following terms

(i) Edge dislocation

(ii) Equiaxed grains

(iii) Columnar grains

(6 marks)

(b) A steel tensile test specimen has a cross sectional area of 200 mm^2 and a gauge length of 50mm, the gradient of the elastic section is 510 x 10^3 N/mm. Determine the modulus of elasticity.

(3 marks)

(c) A metal bar 500mm long and is stretched to 505 mm with a force of 50 kN. The diameter of the bar is 10 mm.

(i) Calculate the Engineering stress and strain.

(ii) The material has remained within the elastic limit. Determine modulus of elasticity of the steel.

(6 marks)

(d) Aluminium exhibits the FCC structure. Its density is 2.70 g/cm^3.

(i) How many aluminium atoms are there in 1 cm^3 of aluminium?

(ii) What is the distance (in meter) between the centers of nearest atoms in aluminium?

(iii) What is the radius (in meter) of the largest interstitial atom which can fit into aluminium without bulging?

(10 marks)

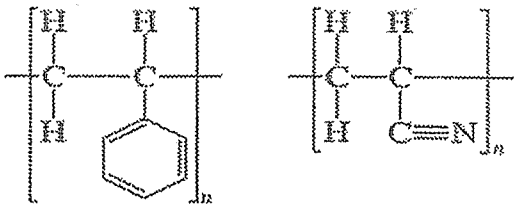
Question 6

(a) Define what is glass. And explain why tempered glass has a higher strength and resistance to impact the annealed glass.

(6 marks)

(b) A copolymer consists of 70 wt % polystyrene and 30 wt % polyacrylonitrile. Calculate the mole fraction of each component in this material.

The structural formulae for polystyrene and polyacrylonitrile are shown below in Figure 6b.



Polystyrene Polyacrylonitrile

Figure 6b

(11 marks)

(c) Explain the following terms obtained from fatigue testing of materials:

(i) Endurance limits (4 marks)
(ii) Surface of fatigue failure (4 marks)

--THE END--

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 can be REMOVED for your convenience.