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INTERNATIONAL COLLEGE PENANG (507232-U)
LAUREATE INTERNATIONAL UNIVERSITIES

FINAL
Examination Paper

(COVER PAGE)

Session : AUGUST 2014

Programme : DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING

Course : EGM1182: STRUCTURES AND PROPERTIES OF MATERIAL

Date of Examination : December 11, 2014 (Thursday)

Time : 3.00pm – 5.00pm 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.

Students are not allowed to remove the question papers from the examination venue.

Materials permitted :

NON-PROGRAMMABLE SCIENTIFIC CALCULATOR

Materials provided :

Nil

Examiner(s)
Moderator

Mr. Phua Chin Lai
Dr. Cheah Kean Seng

This paper consists of 11 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: AUGUST 2014 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) Give the electron configurations for the following ions: Al^{3+} , Cu^+ and S^{2-} . (6 marks)
- (b) What type of bonding is exhibited by Sodium chloride (NaCl). Hence the Na^+ and Cl^- ions have electron structures that are identical to which two inert gases? (3 marks)
- (c) Briefly explain the following primary bonding;
 (i) ionic bonding
 (ii) covalent bonding
 (iii) metallic bonding. (9 marks)
- (d) Show that the atomic packing factor for BCC is 0.68. (7 marks)

Question 2

- (a) Calculate the radius of an iridium atom, given that Ir has an FCC crystal structure, a density of 22.4 g/cm^3 , and an atomic weight of 192.2 g/mol . Given the Avogadro's number is 6.022×10^{23} atoms/mol. (5 marks)
- (b) Rhodium has an atomic radius of 0.1345 nm and a density of 12.41 g/cm^3 . Determine whether it has an FCC or BCC crystal structure. (5 marks)
- (c) Determine the Miller indices for the planes for an unit cell shown in Figure 2.

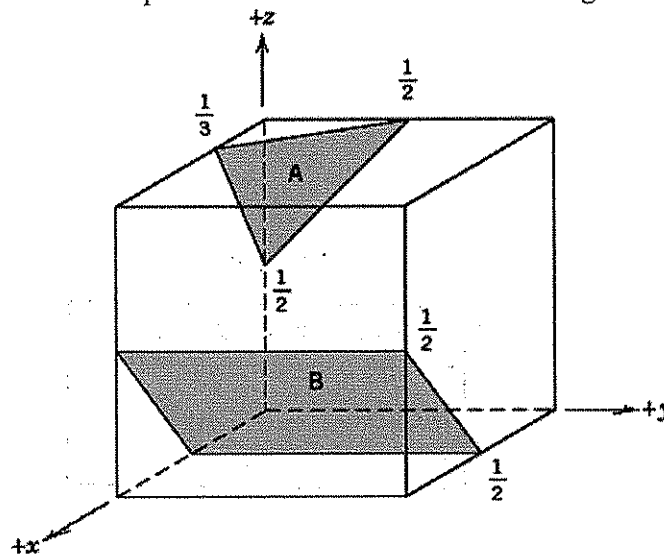


Figure 2

(8 marks)

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

(7 marks)

Question 3

(a) Molybdenum (Mo) forms a substitutional solid solution with tungsten (W). Compute the weight percent of molybdenum that must be added to tungsten to yield an alloy that contains 1.0×10^{22} Mo atoms per cubic centimeter. The densities of pure Mo and W are 10.22 and 19.30 g/cm³, respectively.

(7 marks)

(b) Briefly explain the difference between self-diffusion and interdiffusion. Cite two reasons why interstitial diffusion is normally more rapid than vacancy diffusion.

(8 marks)

(c) A specimen of aluminum having a rectangular cross section 12 mm \times 12.9 mm is pulled in tension with 35,600 N force, producing only elastic deformation. Calculate the resulting strain. (Given the elastic modulus is 69 GPa (or 69×10^9 N/m²))

(3 marks)

(d) A cylindrical rod of copper (the elastic modulus is 110 GPa) having a yield strength of 240 MPa is to be subjected to a load of 6660 N. If the length of the rod is 380 mm, what must be the diameter to allow an elongation of 0.50 mm?

(7 marks)

Question 4

(a) A brass alloy is known to have a yield strength of 275 MPa, a tensile strength of 380 MPa and an elastic modulus of 103 GPa. A cylindrical specimen of this alloy 12.7 mm in diameter and 250 mm long is stressed in tension and found to elongate 7.6 mm. On the basis of the information given, is it possible to compute the magnitude of the load that is necessary to produce this change in length? If so, calculate the load. If not, explain why.

(9 marks)

(b) Figure 4 shows the tensile engineering stress–strain behavior for a steel alloy.

(i) What is the modulus of elasticity? (4 marks)

(ii) What is the proportional limit? (2 marks)

(iii) What is the yield strength at a strain offset of 0.002? (2 marks)

(iv) What is the tensile strength? (2 marks)



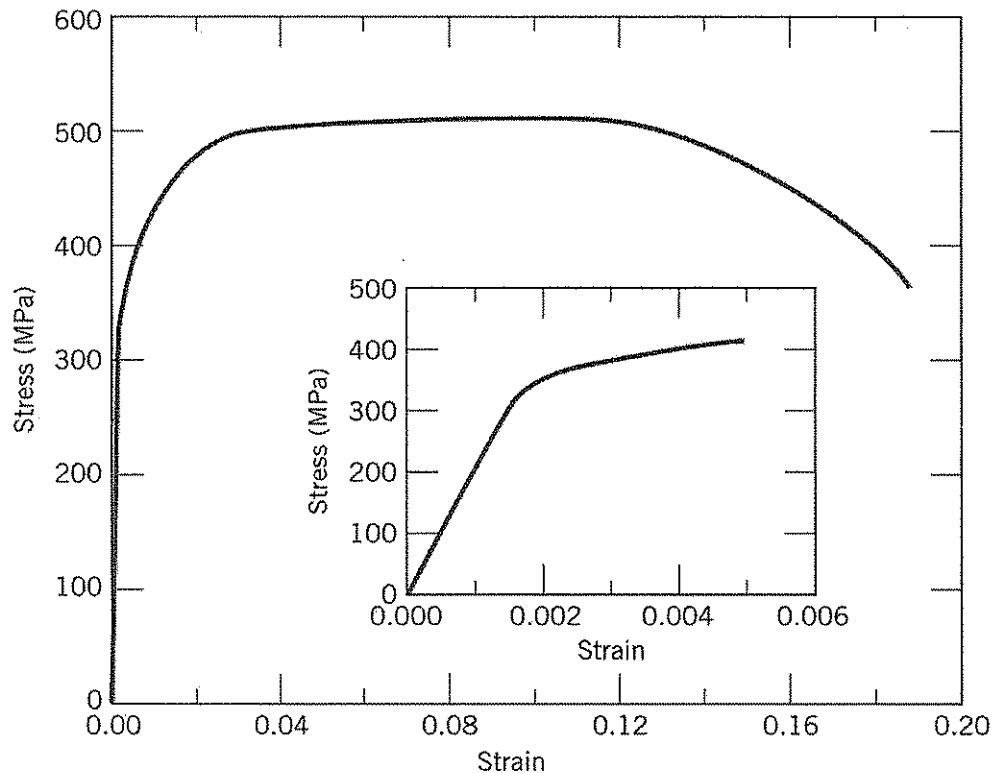


Figure 4

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

(6 marks)

Question 5

(a) Describe the three stages in the ductile fracture of a metal.

(5 marks)

(b) Consider the binary eutectic copper-silver phase diagram in Figure 5. Make phase analyses of an 88 wt % Ag–12 wt % Cu alloy at the temperatures

(i) 1000°C,

(ii) 800°C,

(iii) $780^{\circ}\text{C} + \Delta T$, and

(iv) $780^{\circ}\text{C} - \Delta T$. In the phase analyses, include:

- The phases present
- The chemical compositions of the phases
- The amounts of each phase
- Sketch and label the microstructure by using approximately 2 cm diameter circular fields.

(20 marks)

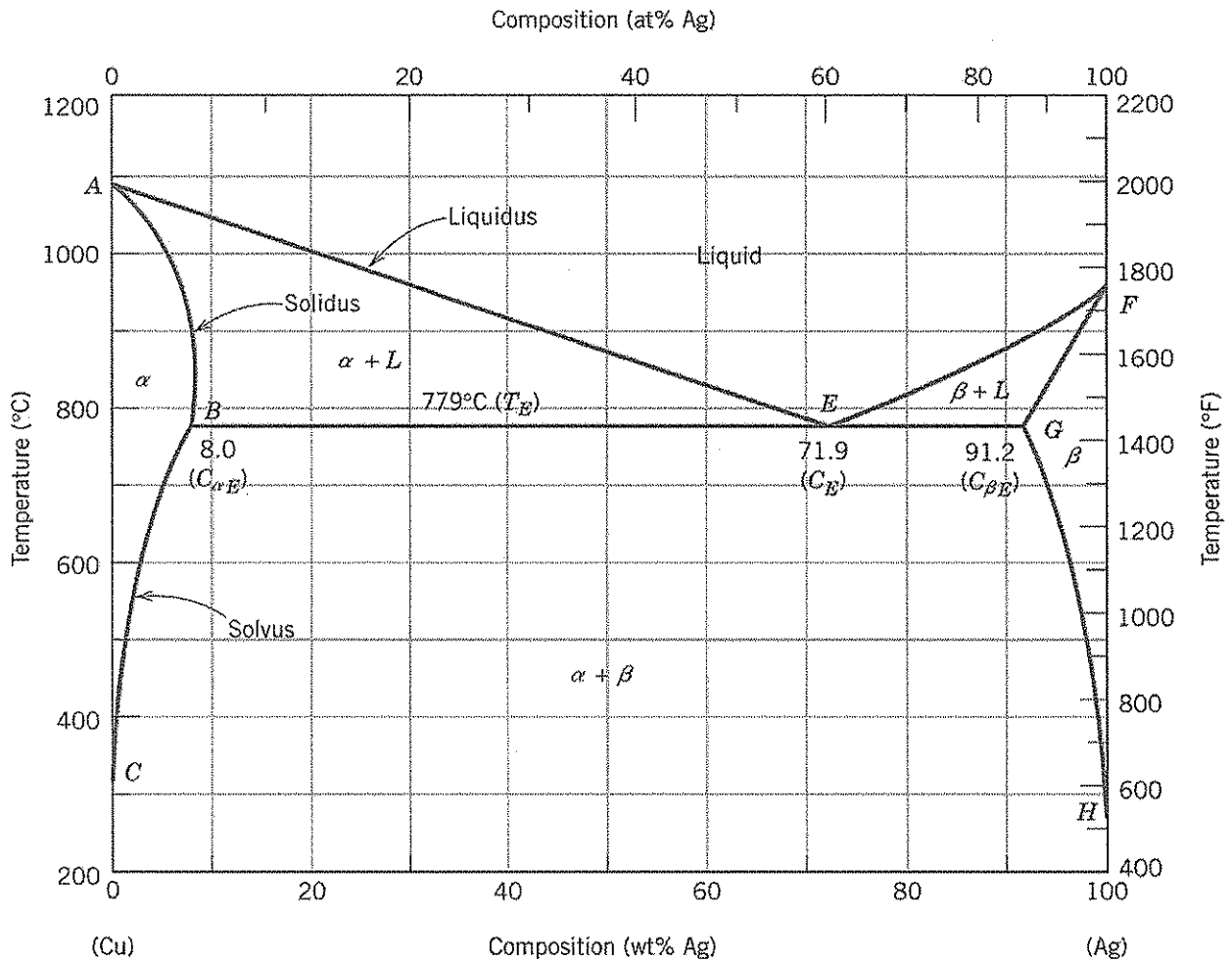


Figure 5

Question 6

(a) 20cm length of rod with a diameter of 0.250 cm is loaded with a 5000 N weight. If the diameter decreases to 0.210 cm, determine

- the engineering stress and strain at this load and
- the true stress and strain at this load.

(7 marks)

(b): Define the polymeric materials

- plastics
- elastomers.

(8 marks)

(c) Assuming that all the valence electrons contribute to the current flow in copper (FCC structure):

- (i) Calculate the mobility of an electron in copper
- (ii) Calculate the average drift velocity for electrons in a 100cm copper wire when 10V are applied

Calculate the above with the given resistivity of copper at 0°C is $1.67 \times 10^{-6} \Omega \cdot \text{cm}$, charge of electron at $1.6 \times 10^{-19} \text{ C}$, lattice constant for copper is $3.62 \times 10^{-8} \text{ cm}$.

(10 marks)

--THE END--

EGM 1182(F)AUG 14/CL PHUA/10/8/14

PERIODIC TABLE

1	H 1.008 Hydrogen	2	He 4.003 Helium
3	Li 6.941 Lithium	4	Be 9.012 Beryllium
11	Na 22.99 Sodium	12	Mg 24.31 Magnesium
19	K 39.10 Potassium	20	Ca 40.08 Calcium
37	Rb 85.47 Rubidium	38	Sr 87.62 Strontium
55	Cs 132.9 Cesium	56	Ba 137.3 Barium
87	Fr — Francium	88	Ra 226.0 Radium
21	Sc 44.96 Scandium	22	Ti 47.88 Titanium
23	V 50.94 Vanadium	24	Cr 52.00 Chromium
41	Nb 92.91 Niobium	42	Mo 95.94 Molybdenum
73	Ta 180.9 Tantalum	74	W 183.9 Tungsten
105	— — —	106	— — —
25	Mn 54.94 Manganese	26	Fe 55.85 Iron
43	Tc 98.91 Technetium	44	Ru 101.1 Ruthenium
75	Re 186.2 Rhenium	76	Os 190.2 Osmium
27	Co 58.93 Cobalt	28	Ni 58.69 Nickel
45	Rh 102.9 Rhodium	46	Pd 106.4 Palladium
77	Ir 192.2 Iridium	78	Pt 195.1 Platinum
29	Cu 63.55 Copper	30	Zn 65.39 Zinc
47	Ag 107.9 Silver	48	Cd 112.4 Cadmium
79	Au 197.0 Gold	80	Hg 200.6 Mercury
31	Ga 69.72 Gallium	32	Ge 72.59 Germanium
49	In 114.8 Indium	50	Sn 118.7 Tin
81	Tl 204.4 Thallium	82	Pb 207.2 Lead
51	Sb 121.8 Antimony	52	Te 127.6 Tellurium
83	Bi 209.0 Bismuth	84	Po — Polonium
33	As 74.92 Arsenic	34	Se 78.96 Selenium
51	Sb 121.8 Antimony	52	Te 127.6 Tellurium
83	Bi 209.0 Bismuth	84	Po — Polonium
15	P 30.97 Phosphorus	16	S 32.07 Sulfur
33	As 74.92 Arsenic	34	Se 78.96 Selenium
51	Sb 121.8 Antimony	52	Te 127.6 Tellurium
83	Bi 209.0 Bismuth	84	Po — Polonium
7	N 14.01 Nitrogen	8	O 16.00 Oxygen
15	P 30.97 Phosphorus	16	S 32.07 Sulfur
33	As 74.92 Arsenic	34	Se 78.96 Selenium
51	Sb 121.8 Antimony	52	Te 127.6 Tellurium
83	Bi 209.0 Bismuth	84	Po — Polonium
6	C 12.01 Carbon	7	N 14.01 Nitrogen
14	Si 28.09 Silicon	15	P 30.97 Phosphorus
32	Ge 72.59 Germanium	33	As 74.92 Arsenic
50	Sn 118.7 Tin	51	Sb 121.8 Antimony
82	Pb 207.2 Lead	83	Bi 209.0 Bismuth
5	B 10.81 Boron	6	C 12.01 Carbon
13	Al 26.98 Aluminum	14	Si 28.09 Silicon
31	Ga 69.72 Gallium	32	Ge 72.59 Germanium
49	In 114.8 Indium	50	Sn 118.7 Tin
81	Tl 204.4 Thallium	82	Pb 207.2 Lead
9	F 19.00 Fluorine	10	Ne 20.18 Neon
17	Cl 35.45 Chlorine	18	Ar 39.95 Argon
35	Br 79.90 Bromine	36	Kr 83.80 Krypton
53	I 126.9 Iodine	54	Xe 131.3 Xenon
85	At — Astatine	86	Rn — Radon

1 H
1.008
Hydrogen

KEY
Atomic Number
Atomic Mass
Symbol of element
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 ~~is~~ to be REMOVED for your convenience.