

 **INTI International
University & Colleges**

FINAL
Examination Paper
(COVER PAGE)

Session : August 2018

Programme : Diploma in Electrical and Electronic Engineering (DEEI)
Diploma in Mechanical Engineering (DMEN)

Course : EGM1182/1184 : Structures and Properties of Materials

Date of Examination : December 7, 2018 (Friday)

Time : 5:00 pm – 7:00 pm 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 : Calculator

Material provided : Periodic Table and List of Formula

Examiner : Iylia Elena Abdul Jamil & Aaron Edward Teo Sheng Jye

Moderator : Mr Abdolreza Toudehdehghan

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

DIPLOMA IN ELECTRICAL AND ELECTRONIC ENGINEERING (DEEI)
DIPLOMA IN MECHANICAL ENGINEERING (DMEN)
EGM1182/1184: STRUCTURES AND PROPERTIES OF MATERIALS
FINAL EXAMINATION: AUGUST 2018 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) Write down the electron configuration of Neon, Na and Na⁺. (6 marks)
- (b) Given Avogadro's number is 6.022×10^{23} atoms/mol. How many atoms are there in:
- (i) One gram of sulfur (S)
 - (ii) One gram of lead (Pb) (4 marks)
- (c) Briefly cite the main differences between ionic, covalent, and metallic bonding. (6 marks)
- (d) What is the composition, in atom percent, of an alloy that contains 45.2 kg copper (Cu), 46.3 kg zinc (Zn), and 0.95 kg lead (Pb)? (9 marks)

Question 2

- (a) For a FCC crystal structure, how many atoms are there per unit cell and what is the coordination number? (4 marks)
- (b) Calculate the atomic packing factor (APF) for FCC structure. (5 marks)

- (c) Determine the Miller indices for the planes A & B shown in the unit cell in Figure Q2 (b).
(6 marks)

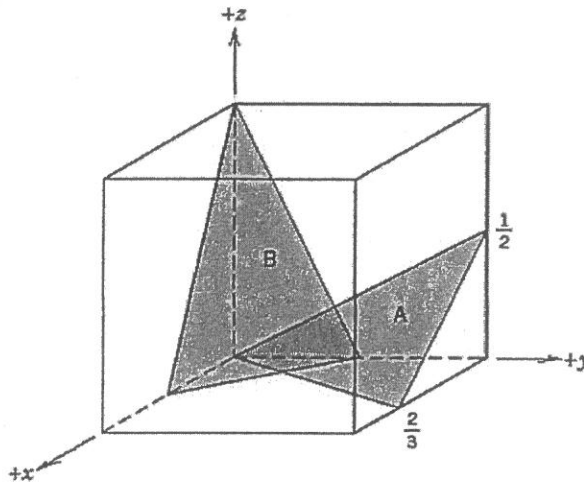


Figure for Q2 (b)

- (d) Determine the indices for directions A and B in the cubic unit cell in Figure Q2c.
(6 marks)

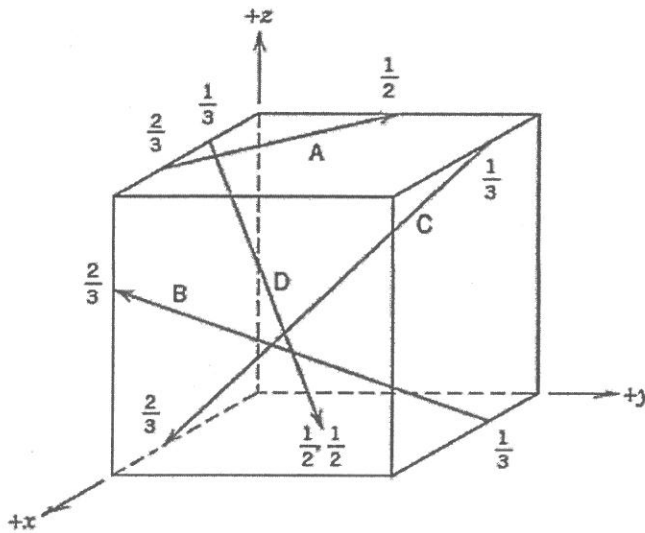


Figure for Q2 (c)

- (e) Dislocations are line defects. Name two types of dislocation.
(4 marks)

Question 3

- (a) What is the composition, in atom percent, of an alloy that contains 100 g tin and 68 g of lead?
(6 marks)
- (b) If there are 600 grains per square inch on a photomicrograph of a metal at 100x, what is its ASTM grain-size number?
(3 marks)
- (c) Briefly explain the following terms: (Include drawing/illustration of your answer)
- (i) Vacancies
 - (ii) Self-interstitials
- (6 marks)
- (d) Figure Q3 (d) shows the phase diagram of Ag-Cu alloy. If an alloy of 88 wt% Ag – 12 wt% Cu is cooled from 1000°C, determine:
- (i) The phase present at $780^{\circ}\text{C} + \Delta T$ and the amount (wt %) of each phase.
 - (ii) The phase present at $780^{\circ}\text{C} - \Delta T$ and the amount (wt %) of each phase.
- (10 marks)

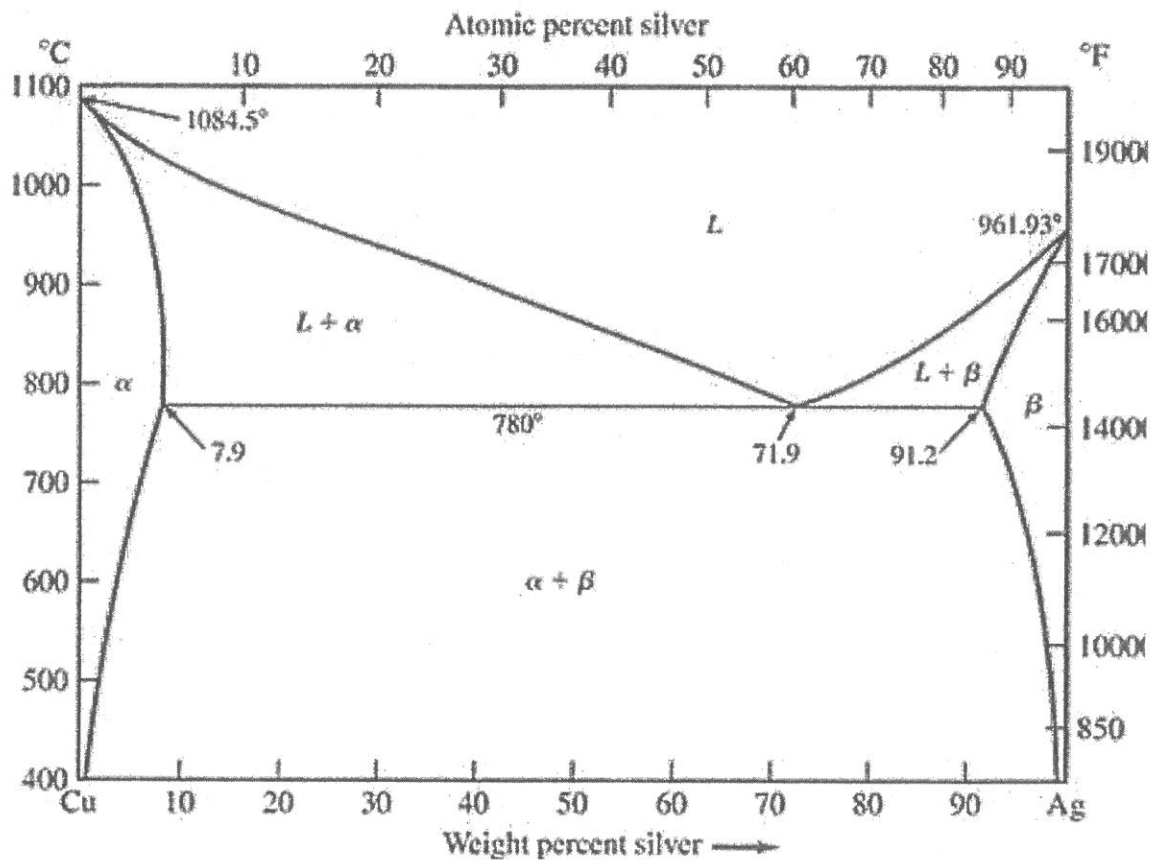


Figure for Q3 (d)

Question 4

- (a) What is the formula for mean stress, stress amplitude, stress range and stress ratio. (8 marks)
- (b) A fatigue test is made with a maximum stress of 172 MPa and a minimum stress of -27.6 MPa. Calculate:
- the stress range
 - the stress amplitude
 - the mean stress
 - the stress ratio
- (8 marks)
- (c) Briefly explain the difference between elastic and plastic deformation. (4 marks)
- (d) Briefly explain the difference between engineering stress and true stress. Which has a larger magnitude? (5 marks)

Question 5

- (a) Define the modulus of elasticity. Does a stiffer material have higher or lower modulus of elasticity compared to a softer material?
(3 marks)
- (b) A steel bar 100 mm long and having a square cross section 20 mm x 20mm is pulled in tension with a load of 89,000 N. The bar experiences an elongation of 0.10 mm. Calculate the modulus of elasticity of the steel assuming that the deformation is entirely elastic.
(6 marks)
- (c) When a strain hardened metal is heated at high temperature where recovery takes place, describe how the following characteristics are affected:
(8 marks)
- (i) internal residual stresses
 - (ii) strength
 - (iii) ductility
 - (iv) hardness
- (d) List down **FOUR (4)** common properties of most ceramic materials.
(8 marks)

Question 6

- (a) Briefly explain what tempered glass is. Name **ONE (1)** application for tempered glass.
(4 marks)
- (b) Briefly explain the difference between thermoplastic and thermosetting plastic and name **TWO (2)** products made from each material.
(8 marks)
- (c) At what temperature will the electrical resistivity of an iron wire be $25.0 \times 10^{-8} \Omega \text{ cm}$ (Resistivity for iron at $0^\circ\text{C} = 9.0 \times 10^{-6} \Omega \text{ cm}$, coefficient of resistivity = $0.0045^\circ\text{C}^{-1}$)
(4 marks)
- (d) A 5.0 mm diameter, 50 mm long cylindrical silicon specimen has a current of 0.1 A passing in axial direction. A voltage of 12.5 V is measured across two probes that are separated by 38 mm.
(9 marks)
- (i) Find the electrical conductivity of the specimen.
 - (ii) Compute the resistance over the entire 50 mm of the specimen.

Periodic Table of the Elements

1 IA 1A		2 IIA 2A		3-10 IIIB 3B IVB 4B VB 5B VIB 6B VIIB 7B 8 VIII 9 10 11 IB 12 IIB 2B										13 IIIA 3A		14 IVA 4A		15 VA 5A		16 VIA 6A		17 VIIA 7A		18 VIIIA 8A																																																																																																																																																																																															
Atomic Number	Symbol	Name	Atomic Mass																																																																																																																																																																																																																				
1	H	Hydrogen	1.00784(1)	3	Li	Lithium	6.941	4	Be	Beryllium	9.012182(2)	11	Na	Sodium	22.98976928(2)	12	Mg	Magnesium	24.304	19	K	Potassium	39.0983(1)	20	Ca	Calcium	40.078(4)	37	Rb	Rubidium	85.4678(3)	55	Cs	Cesium	132.90545196(3)	87	Fr	Francium	<223>	57	La	Lanthanum	138.9047(1)	89	Ac	Actinium	227.0277(1)	21	Sc	Scandium	44.955912(3)	39	Y	Yttrium	88.90584(3)	57-71	Lanthanide Series					89-103	Actinide Series					2	He	Helium	4.002602(2)	10	Ne	Neon	20.1797(6)	18	Ar	Argon	39.948(1)	36	Kr	Krypton	83.799(4)	54	Xe	Xenon	131.29(4)	86	Rn	Radon	<222>	118	Uuo	Ununocium	unknown	5	B	Boron	10.811(7)	13	Al	Aluminum	26.9815386(3)	31	Ga	Gallium	69.723(1)	49	In	Indium	114.818(1)	81	Tl	Thallium	204.384(3)	113	Uut	Ununtrium	unknown	6	C	Carbon	12.0107(8)	14	Si	Silicon	28.0855(8)	32	Ge	Germanium	72.630(8)	50	Sn	Tin	118.710(7)	82	Pb	Lead	207.2(1)	114	Fl	Flerovium	<288>	7	N	Nitrogen	14.00643(4)	15	P	Phosphorus	30.973762(3)	33	As	Arsenic	74.9216(3)	51	Sb	Antimony	121.757(3)	83	Bi	Bismuth	208.9804(1)	115	Uup	Ununpentium	unknown	8	O	Oxygen	15.999(4)	16	S	Sulfur	32.06(2)	34	Se	Selenium	78.9718(8)	52	Te	Tellurium	127.60(3)	84	Po	Polonium	<209>	116	Lv	Livermorium	<293>	9	F	Fluorine	18.9984032(3)	17	Cl	Chlorine	35.446(3)	35	Br	Bromine	79.904(3)	53	I	Iodine	126.90447(3)	85	At	Astatine	<210>	117	Uus	Ununseptium	unknown

- THE END -

LIST OF FORMULA

1. Atomic packing factor, $APF = \frac{\text{volume of atoms in a cell}}{\text{volume of cubic cell}}$
2. Number of grains in 100x magnification, $N = 2^{n-1}$
3. Stress, $\sigma = \frac{F_o}{A}$
4. Strain, $\varepsilon = \frac{\Delta l}{l_o}$
5. Modulus of elasticity, $E = \frac{\sigma}{\varepsilon}$
6. Resistivity, $\rho = \frac{VA}{Il}$
7. Resistivity at specified temperature, $\rho_T = \rho_{0^\circ\text{C}}(1 + \alpha_T T)$
8. Conductivity, $\sigma = \frac{1}{\rho}$
9. Resistance, $R = \frac{\rho l}{A}$
10. Lever Rule:
 - a. Weight fraction of Phase A, $X_A = \frac{w_B - w_0}{w_B - w_A}$
 - b. Weight fraction of Phase B, $X_B = \frac{w_0 - w_A}{w_B - w_A}$