Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	ENGINEERING TECHNOLOGY MATERIALS
COURSE CODE	:	BDU 10603
PROGRAMME CODE	:	1 BDM/1 BDC
EXAMINATION DATE	:	JUNE /JULY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **ONLY FIVE (5)** QUESTIONS FROM **SIX (6)** QUESTIONS PROVIDED

THIS QUESTION PAPER CONSISTS OF **FIVE (5)** PAGES

Q1 (a) Differentiate between metal, polymer and ceramic in terms of the elemental content or elemental combinations that made up the materials.

(3 marks)

(b) Solid materials can be divided to crystalline materials and non-crystalline materials. Distinguish these materials in terms of energy and packing. Use appropriate figure in your answer.

(5 marks)

(c) Most metals crystallize into three crystal packed structures namely body centered cube, face centered cube and hexagonal close-packed structure. Based on the volume of a cell unit and spheres, show the atomic packing factor for the structure with the lowest packing factor.

(6 marks)

(d) Use your knowledge about crystallographic plane to determine the atomic density at (110) of α-Fe with a body centered cube lattice in atom per millimeter. The lattice constant for α-Fe is 0.287 nm.

(6 marks)

Q2 (a) Explain the defects that occur in pure metals.

(2 marks)

(b) Describe the differences between point defects and linear defects.

(4 marks)

(c) The Second Fick's Law used in a non-steady state diffusion with a condition in which the diffusion constant is independent of the concentration is given as the following:

$$\frac{\partial C}{\partial t} = D\frac{\partial^2 C}{\partial x^2}$$

Sketch a concentration profile for a non-steady state diffusion by showing all the concentration parameters involved.

(4 marks)

(d) If boron is diffused into a thick slice of silicon with no previous boron in it at a temperature of 1100°C for 5 h, calculate the depth below the surface at which the concentration is 10^{17} atoms/cm^3 if the surface concentration is 10^{18} atoms/cm^3.

D = 4 x 10^{-13} cm^2/s for boron diffusing in silicon at 1100°C.

(10 marks)

Q3 (a) Distinguish the following behaviors of a material. Support your statement with a stress-strain diagram.

(i) Material that behaves elastically.
(ii) Material that behaves plastically.

(10 marks)

(b) Illustrate FOUR (4) specimen geometries of a deformed specimen which underwent the tensile test.

(4 marks)

(c) You are required to conduct types of impact tests on a specimen. Explain both of this impact tests by the assistance of appropriate illustration of the samples.

(4 marks)

(d) Explain the difference between a fatigue test and a creep test.

(2 marks)

Q4 (a) Define the following term
(i) Phase
(ii) Ternary alloy

(2 marks)

(b) In the following is the information that need to construct the phase diagram XY. Sketch the system by using an appropriate scale and label all the important points.

The Metal X and Metal Y were found to form a binary system.
Melting point of pure metal X is 1080°C
Melting point of pure metal Y is 1450°C.
Eutectic reaction happens at 1025 °C, 40 wt% Y.
Maximum solubility of X in Y is 5 wt%.
Maximum solubility of Y in X is 2.5 wt%.

(6 marks)

(c) Compare and contrast the important information from TTT diagram and phase diagram.

(8 marks)

(d) Differentiate the pearlite and martensite microstructure in terms of their properties.

(4 marks)

Q5 (a) The usage of nonferrous alloy is preferable due to some distinct limitations of ferrous alloy. State TWO (2) disadvantages of ferrous alloy.

(4 marks)

(b) Describe the slip casting technique in ceramic fabrication.

(5 marks)

(c) Select one type of material that suitable for the following application and justify your answer.

(i) Bicycle frame
(ii) Cutting tools

(3 marks)

(d) Distinguish the properties and structure of thermoplastic and thermoset.

(8 marks)

Q6 (a) Explain the significant of using reinforcement in composite materials.

(4 marks)

(b) A continuous and aligned glass fiber-reinforced composite consists of 40 vol% of glass fibers having a modulus of elasticity of 69 GPa and 60 vol % of a polyester resin that, when hardened, displays a modulus of 3.4 GPa. If the cross-sectional area is 250 mm^2 and a stress of 50 MPa is applied in this longitudinal direction (isostrain), compute the magnitude of the load carried by each of the fiber and matrix phases.

(7 marks)

(c) Compare the THREE (3) types of composite materials according to types of reinforcement.

(9 marks)

-END OF QUESTIONS –

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Table 1 : Tabulation of Error Function Values

z	$erf\ z$	z	$erf\ z$	z	$erf\ z$
0	0	0.55	0.5633	1.3	0.9340
0.025	0.0282	0.60	0.6039	1.4	0.9523
0.05	0.0564	0.65	0.6420	1.5	0.9661
0.10	0.1125	0.70	0.6778	1.6	0.9763
0.15	0.1680	0.75	0.7112	1.7	0.9838
0.20	0.2227	0.80	0.7421	1.8	0.9891
0.25	0.2763	0.85	0.7707	1.9	0.9928
0.30	0.3286	0.90	0.7970	2.0	0.9953
0.35	0.3794	0.95	0.8209	2.2	0.9981
0.40	0.4284	1.0	0.8427	2.4	0.9993
0.45	0.4755	1.1	0.8802	2.6	0.9998
0.50	0.5205	1.2	0.9103	2.8	0.9999

Figure Q2(d)