Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2022/2023

COURSE NAME	:	ENGINEERING TECHNOLOGY MATERIALS
COURSE CODE	:	BDU 10603
PROGRAMME CODE	:	BDC
EXAMINATION DATE	:	JULY/AUGUST 2023
DURATION	:	3 HOURS
INSTRUCTION	:	1. ANSWER **ONLY FOUR (4)** QUESTIONS FROM **FIVE (5)** QUESTIONS PROVIDED 2. THIS FINAL EXAMINATION IS CONDUCTED VIA **CLOSED BOOK** 3.STUDENTS ARE **PROHIBITED** TO CONSULT THEIR OWN MATERIAL OR ANY EXTERNAL RESOURCES DURING THE EXAMINATION CONDUCTED VIA CLOSED BOOK

THIS QUESTION PAPER CONSISTS OF **FOUR (4)** PAGES

Q1 (a) Distinguish and describe the relationship between structure, properties and processing of the material in materials science and engineering.

(8 marks)

(b) Describe the packing arrangement of atoms in a material, such as crystalline or non-crystalline, influence its properties, and relate this knowledge be used to design materials with specific properties for aerospace applications? Provide relevant examples to support your answer.

(8 marks)

(c) Differentiate the atomic packing factor between a body-centered cubic (BCC) and a face-centered cubic (FCC) crystal structure? Identify which structure exhibits a greater atomic packing factor and state the reason for this? Explain briefly and include a numerical example for Gold that has both crystal structures. Given, Gold has an FCC crystal structure with a lattice constant of 4.08 Å and BCC crystal structure has a lattice constant of 4.16 Å.

(9 marks)

Q2 (a) Classify point defects based on their origin and describe the effects of each type of defect on the properties of the crystal.

(5 marks)

(b) Compare the different diffusion mechanisms in solid materials, including vacancy diffusion and interstitial diffusion, and analyze the factors that govern each mechanism's behavior at different temperatures and compositions.

(12 marks)

(c) Explain the difference between elastic and plastic deformation and provide examples of materials that exhibit each type of deformation under different loading conditions.

(8 marks)

Q3 (a) With reference to **Table Q(3) (a)**, construct the Mo-V phase diagram and determine the melting point of Molybdenum (Mo) and Vanadium (V).

(8 marks)

(b) Analyze the effect of cooling rates on the microstructure of steel in the Time-Temperature-Transformation (TTT) diagram and predict the resulting mechanical properties.

(8 marks)

(c) Compare the microstructures and mechanical properties of steel subjected to annealing, normalizing, and quenching, and propose the optimal heat treatment process for a given steel application.

(9 marks)

Q4 (a) Compare the mechanical properties of polymers commonly used in aerospace applications with those of metals and ceramics.

(i) Determine common properties of polymers shared with each of these materials, and differentiate them in terms of properties such as strength, toughness, and thermal conductivity.

(10 marks)

(ii) Provide examples of specific polymer materials used in aerospace.

(3 marks)

(b) Distinguish the differences between the fabrication processes used for polymers, metals, and ceramics and evaluate how the choice of fabrication method impacts the final properties of each material.

(12 marks)

Q5 (a) Relate the function of matrix, reinforcement, and interface in composite materials. Explain how each component contributes to the mechanical properties of the composite material and describe how they work together to improve these properties.

(8 marks)

(b) Examine the characteristics of polymer matrix composites and ceramic composites, and determine one appropriate application for each composite type, providing a reason for your choice.

(12 marks

(c) Compare the different types of semiconductors, including intrinsic and extrinsic semiconductors. Describe how doping affects the electrical properties of semiconductors, and how this knowledge can be applied to design semiconductor materials with specific properties.

(5 marks)

- END OF QUESTIONS -

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Table Q3 (a) : Data from cooling curve of Mo-V

Composition of Vanadium (V) (%)	**$T_{Liquidus}$ (°C)**	**$T_{Solidus}$ (°C)**
0	**2630**	-
20	**2500**	**2320**
40	**2360**	**2160**
60	**2220**	**2070**
80	**2100**	**1970**
100	**1930**	-