UTHM
Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
(ONLINE)
SEMESTER I
SESSION 2020/2021

COURSE NAME	:	MATERIALS SCIENCE
COURSE CODE	:	BDA 10803
PROGRAMME	:	BDD
EXAMINATION DATE	:	JANUARY / FEBRUARY 2021
DURATION	:	3 HOURS
INSTRUCTION	:	**SECTION A IS COMPULSORY** **SECTION B** – ANSWER **THREE** (3) QUESTIONS **ONLY**

TERBUKA

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

SECTION A

Q1 (a) State TWO (2) functions of phase diagram.

(2 marks)

(b) The metallic alloy A-B starts to melt at 150°C. However, the melting process of pure metal A is complete at 250°C while the melting point of pure metal B is complete at 330°C. The eutectic phase is observed when 60wt% of pure metal A combine with metal B. Sketch with an appropriate label the phase diagram of metallic alloy A-B.

(4 marks)

(c) Based on the sketched phase diagram in Q1(b), analyze the constitution point for A- 80wt% B at 150°C + ΔT .

(i) What phases are present?

(2 marks)

(ii) Interpret each phase composition.

(2 marks)

(iii) Find amount of weight proportion for each fraction.

(4 marks)

(d) Explain in details the effect of annealing and normalizing on carbon steel.

(6 marks)

Q2 (a) In a secret lab, Tony Stark invented an armour using a mysterious material that contains 30 wt% of iron, 0.8 wt% of carbon, 40 wt% of titanium and 28.2 wt% of aluminium. Define Mr. Stark's mysterious materials.

(? marks)

(b) Which one is ceramic materials – aluminium nitride or aluminium nitrate? Explain from the physical properties point of view. Limit your answer to THREE (3) physical properties only.

(6 marks)

(c) FKMP Materials Lab wants to produce a bowl (**Figure Q2(c)**) from (i) metal,and (ii) ceramic, as visitors' token. Based on fabrication techniques that you have learnt recently, how these mugs can be simply and cheaply produced in house? You may use appropriate sketches and labels to support your answer.

(12 marks)

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SECTION B

Q3 (a) Define unit cell with an appropriate sketch.

(2 marks)

(b) Niobium has an atomic radius of 0.1430 nm and a density of 8.47 g/cm³. Determine whether it has FCC or BCC crystal structure. Given the atomic weight of Niobium is 91.92 g/mol

(6 marks)

(c) Company ABC is planning to develop a new surgical implant. As an engineer, choose a suitable metal that has suitable properties to be used as an implant.

(12 marks)

Q4 (a) The mechanical behaviour of a material reflects its response or deformation behaviour when exposed to an applied load or force. List FOUR (4) types of applied load that can be used to determine the mechanical performance of materials.

(2 marks)

(b) In terms of atomic bonding, please explain why plastic deformation does not occur in noncrystalline ceramics?

(6 marks)

(c) Ductility is a measure of the degree of plastic deformation that has been sustained at fracture. A metal that experiences very little or no plastic deformation upon fracture is termed brittle. Sketch the schematic graph of tensile stress–strain behaviour for brittle and ductile metals loaded to fracture.

(6 marks)

(d) There are three basic powder-pressing procedures: uniaxial, isostatic (or hydrostatic), and hot pressing. Please demonstrate the steps involve in uniaxial pressing with schematic figure.

(6 marks)

Q5 (a) State TWO (2) factors that are favourable for extensive solid solubility takes place in one element to another.

(2 marks)

(b) Steady state diffusion is defined as the concentration profile does not change with time. Explain this process and the law related with this process.

(6 marks)

(c) (i) The diffusivity of copper atoms in the aluminum lattice is 7.5×10^{-13} m²/s at 600°C and 2.5×10^{-15} m²/s at 400°C. Calculate the activation

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energy in kJ/mol for this case in this temperature range. [R = 8.314 J/(mol·K).].

(4 marks)

    (ii)   Ilustrate by using time-temperature-transformation (TTT) diagram for the process of steel martempering and austempering by showing their plots

(8 marks)

Q6   (a)   The physical characteristics of a polymer depend not only on its molecular weight and shape, but also on differences in the structure of the molecular chains. Define the following chain type of polymers:

    (i)   Crosslinked polymer

(1 marks)

    (ii)   Network polymer

(1 marks)

    (b)   Carbon-reinforced polymer (CFRP) composites are currently being used extensively in sports and aircraft structural components. Please discuss why CFRP is the most commonly used reinforcement in advanced (i.e., nonfiberglass) polymer-matrix composites?

(6 marks)

    (c)   Choose one type of advanced material for medical implant application and what is the requirement for this material in biomedical system.

(6 marks)

    (d)   Metal foam is a cellular structure made up of a solid metal containing a large volume fraction of gas-filled pores. Sketch the 'blowing agent' foaming method and write this process.

(6 marks)

-END OF QUESTIONS –

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Figure Q2(c)