Universiti Tun Hussein Onn Malaysia

UNIVERSITI TUN HUSSEIN ONN MALAYSIA

FINAL EXAMINATION
SEMESTER II
SESSION 2018/2019

COURSE NAME	:	MATERIALS SCIENCE
COURSE CODE	:	BDA 10803
PROGRAMME	:	BDD
EXAMINATION DATE	:	JUNE/JULY 2019
DURATION	:	3 HOURS
INSTRUCTION	:	ANSWER **FIVE (5)** QUESTIONS **ONLY**

THIS QUESTION PAPER CONSISTS OF **SIX (6)** PAGES

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Q1 (a) State TWO (2) properties of ceramic material.

(2 marks)

(b) Explain the simple or basic route of making process for clay product.

(6 marks)

(c) Determine the following directions and planes in a cubic unit cell:

(i) $[0\ \bar{2}\ \bar{1}]$

(ii) $[1\ 1\ \bar{1}]$

(iii) $(1\ \bar{1}1)$

(iv) $(\bar{1}10)$

(8 marks)

(d) Prove the atomic packing factor for simple cubic (SC) is 0.52.

(4 marks)

Q2 (a) (i) State the difference between BCC and FCC crystalline structure by giving an appropriate sketch of atomic arrangement for both structures.

(2 marks)

(ii) Based on the above crystal structure of FCC, determine the planar atomic density, ρ_p of γ-iron FCC at (110) which has a lattice constant a, 0.340 nm.

(8 marks)

(b) Sketch the true strain and stress behavior consist of two deformation mechanisms which are elastic deformation and plastic deformation. Please differentiate both mechanisms using plot of stress and strain curve by providing some illustration on the material changes and condition at each critical points of this plot.

(4 marks)

(c) Explain the main factor that should be considered for any engineering component to avoid creep and fatigue failure. Give also a plot for creep and fatigue failure.

(6 marks)

Q3 (a) Give TWO (2) types of alloy steel.

(2 marks)

(b) Explain the steps in the investment casting process of metal component.

(6 marks)

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(c) Determine the comparison between true stress and strain for the tensile test of a low-carbon steel which has the following test values;

Load applied to the specimen = 120 N
Initial Area = 0.19 m^2
Area under load = 0.13 m^2

(8 marks)

(d) Analyze the different between ductile and brittle fracture of materials by giving an appropriate plot of stress and strain that exposed uniaxial tensile load and state.

(4 marks)

Q4 (a) A binary system of type A and B has a simple eutectic phase diagram. Melting temperature of type A was at 850 °C, while type B at 650 °C. The A-rich solid solution (α) has a maximum solubility of 8 wt% B at eutectic temperature (500 °C), but dissolves much less than 1 wt% B at room temperature. The B-rich solution (β) has a maximum solubility of 5 wt% A at eutectic temperature, and dissolves 2 wt% A at room temperature. Sketch the qualitative form of the phase diagram and label the phase fields.

(8 marks)

(b) Differentiate between martensite and bainite structure in Fe-C system.

(4 marks)

(c) Define polymerization.

(2 marks)

(d) Identify a suitable class of polymer and give an example for each of the following application.

(i) Used to make car bumpers
(ii) Commonly used as food containers
(iii) Used to make a car tyres.

(6 marks)

Q5 (a) State TWO (2) conditions must be made for diffusion process.

(2 marks)

(b) The diffusivity of silver (Ag) atoms in solid silver metal is 1.0×10^{-17} m^2/s at 500°C and 7.0×10^{-13} m^2/s at 1000°C. Calculate the activation energy (joules per mole) for the diffusion of Ag in Ag in the temperature range 500 to 1000°C .

(8 marks)

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(c) Explain the benefits of fabricating ceramic matrix composite, metal matrix composite and polymer matrix composite in term of mechanical properties.
(6 marks)

(d) Differentiate in between continuous and discontinuous fiber used as reinforcement in composite.
(4 marks)

Q6 (a) By interpreting phase diagram of Cu-Ag (Refer **Figure Q6 (a)**), solve phase analysis for composition of 71.9 wt% Ag at 778°C. Interpret each phase composition and amount of weight proportion for each fraction.
(4 marks)

(b) Define heat treatment.
(2 marks)

(c) **Figure Q6 (c)** shows TTT diagram for a Fe - 0.6 wt.% C steel alloy. Sketch and label the time-temperature paths to produce the 50% pearlite, 50% bainite microstructure.
(4 marks)

(d) Identify FIVE (5) factors affected the diffusivity.
(5 marks)

(e) Solid solution are made of a host which dissolves the minor component. TWO (2) types of solid solution are substitutional and interstitial. Distinguish between these two types..
(5 marks)

-END OF QUESTION-

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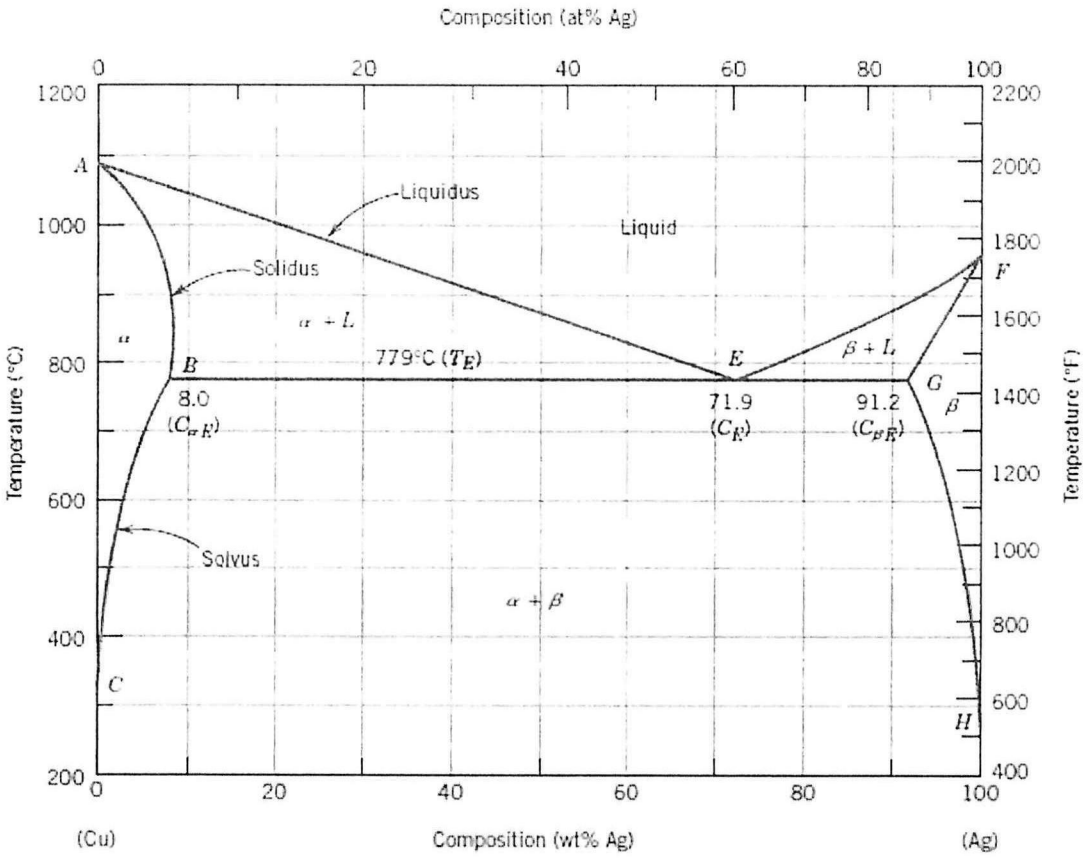

Figure Q6 (a)

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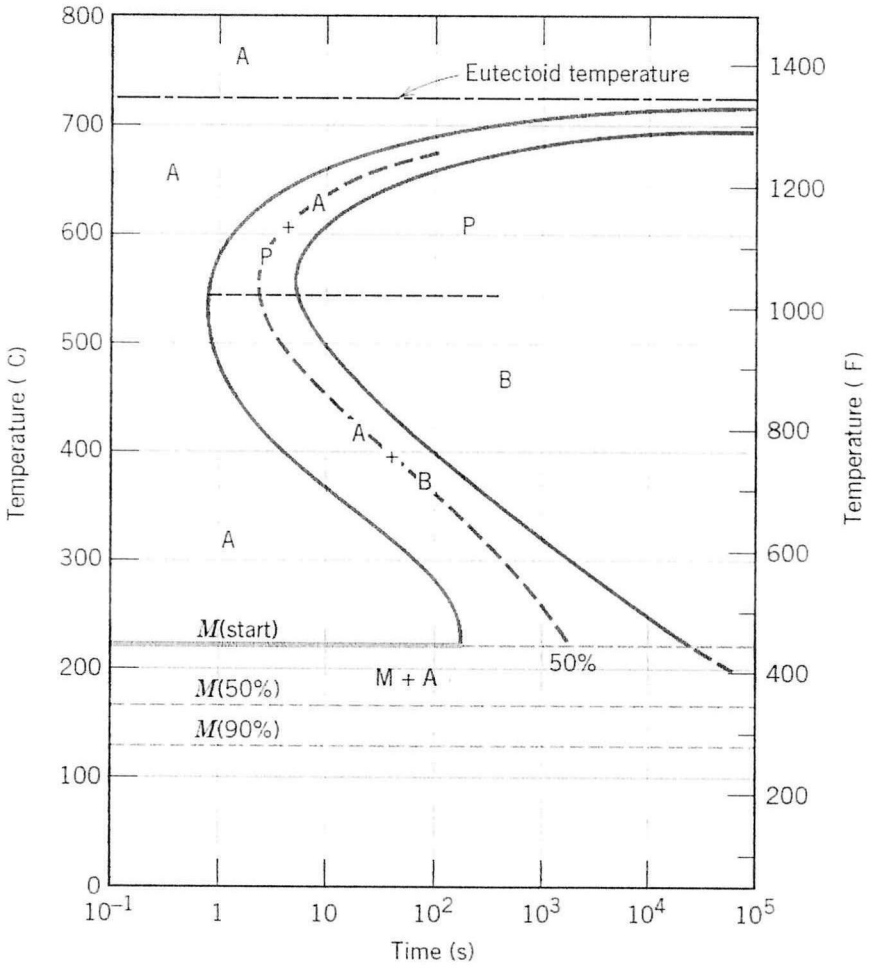

Figure Q6 (c)

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