

The Open University of Sri Lanka
Faculty of Engineering Technology
Department of Mechanical Engineering

094



Study Programme	: Bachelor of Technology Honours in Engineering
Name of the Examination	: Final Examination
Course Code and Title	: DMX3203 Introduction to Engineering Materials
Academic Year	: 2022/23
Date	: 05 th February 2024
Time	: 09:30 hours -12:30 hours
Duration	: 3 hours

General instructions

1. Read all instructions carefully before answering the questions.
 2. This question paper consists of **Five (05)** questions and answers all questions.
 3. Answer for each question should commence from a new page.
 4. This is a Closed Book Test (**CBT**).
 5. Answers should be in clear handwriting.
 6. Do not use Red colour pen.
 7. Write the name of the question paper with course code on the first page of the answer book.
 8. Write your index number (not the registration number) on every page of your answer book.
 9. Write in the bottom of the first page of your answer book clearly the question numbers you answered.
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Question 01

- (a) Discuss the importance of materials in the field of Engineering. (03 marks)
- (b) i) State general properties and characteristics of metals, polymers, ceramics, and composite materials. Give three examples belonging to each group. (06 marks)
ii) Differentiate between thermoplastics and thermosetting plastics. Give two examples for each type of plastic. (06 marks)
- (c) Copper (FCC) has an atomic mass of 63.54g/mol and atomic radius of 0.1278 nm. Calculate a theoretical value for the density of copper in g/cm³. Avogadro's number is 6.02x10²³ atoms/mol. (05 marks)

Question 02

- (a) From Figure Q2 (a), start with an alloy with 50 w/o (weight percent) of B. The temperature is increased to bring this alloy into the two-phase region. Values of w_L and w_α are 10 and 60 w/o, respectively. How much of this alloy is in the form of a liquid? [w_L weight fraction of liquid phase and w_α weight fraction of solid phase] (06 marks)

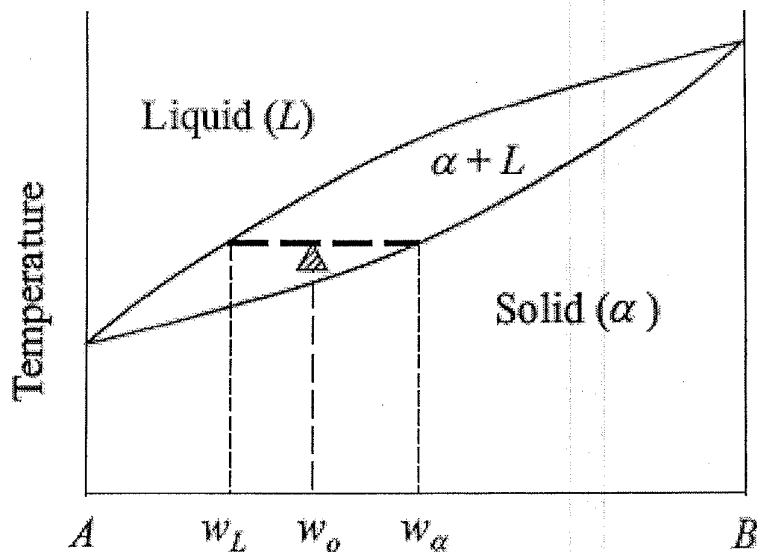


Figure Q2 (a): Schematic phase diagram for alloy AB

- (b) Answer the following questions using Fe-C phase diagram [Figure Q02(b)].
- When eutectoid steel is cooled to below 727°C, solid-state transformation occurs, resulting in the formation of a mixture of ferrite (α -Fe) and cementite (Fe_3C). Determine the weight fraction of cementite in eutectoid steel at slightly below 727°C. (05 marks)
 - At carbon concentration of 0.5 weight percent, estimate the temperature at which the FCC-BCC transformation occurs. (05 marks)
 - Is it possible for the FCC-BCC transformation to take place when the sample undergoes rapid cooling to low temperatures? Provide reasons for either the occurrence or non-occurrence of this transformation. (04 marks)

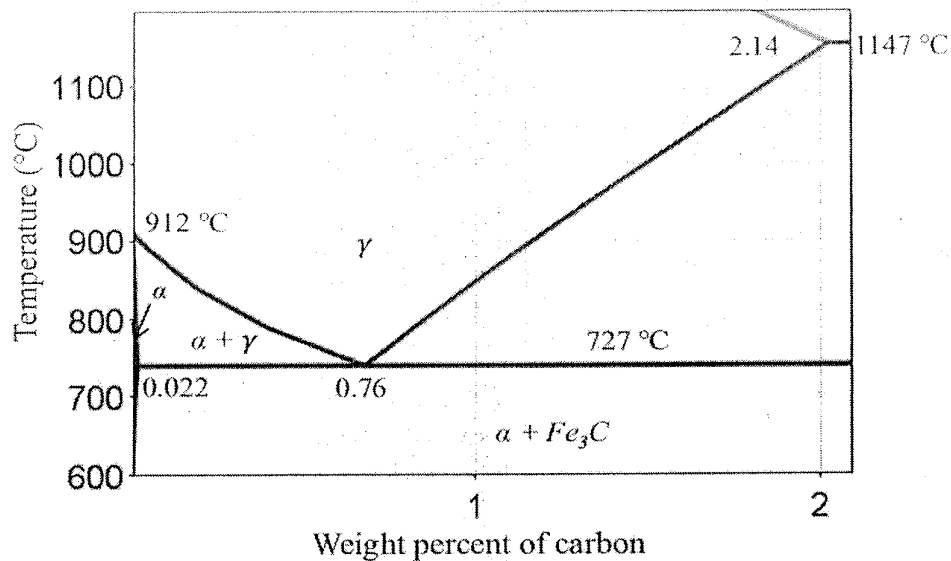


Figure Q2(b): The Fe-C phase diagram.

Question 03

- (a) i) State the ordinary elastic behaviour of materials? (04marks)
 ii) What are the methods available to increase the elastic modulus of a material? (04 marks)
 iii) Explain the stress-strain tests which can be used to determine the mechanical characteristics of metals? (03 marks)
- (b) i) A brass rod is to be used in an application requiring its ends to be held rigid. The rod is stress free at 20°C. Determine the maximum temperature to which the rod may be heated without exceeding a compressive stress of 172 MPa. Given, modulus of elasticity = 100 GPa for brass and Linear expansion coefficient $\alpha = 20 \times 10^{-6}/^{\circ}\text{C}$. (05 marks)
 ii) Discuss how thermal stresses are generated and how they affect the material in service. (04 marks)

Question 04

- (a) i) What do you understand by work hardening? (03 marks)
 ii) Define the term "*fatigue*" and mention the characteristic fatigue surface features. (05 marks)
 iii) What are the different methods of heat treatments which are served for different purposes? (04 marks)
- (b) i) Explain the term "*corrosion*". (03 marks)
 ii) What are the different types of corrosion? (02 marks)
 iii) State the main methods of corrosion prevention. (03 marks)

Question 05

- (a) i) What is meant by semiconductivity? Name two semiconductor materials. (04 marks)
ii) Briefly explain "*Extrinsic Semiconductors*". (04 marks)
iii) Name the three energy bands which affect the electrical conductivity of a material and briefly describe one of them. (06 marks)
- (b) Briefly explain the important functions of integrated circuit (IC) packaging material. While proposing suitable packaging material considering the functionality and ease of manufacturing, justify your answer. (06 marks)

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