

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



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	: 2020/21
Date	: 08 th February 2022
Time	: 1400 - 1700hrs
Duration	: 3 hours

General Instructions

1. Read all instructions carefully before answering the questions.
2. This question paper consists of **Two (2)** parts in **Seven (7)** pages.
3. Answer **All** questions in **Part A** and **Four(4)** questions from **Part B**.
6. This is a Closed Book Test(CBT).
7. Answers should be in clear handwriting.
8. Do not use Red colour pen.

SECTION A (ANSWER ALL QUESTIONS)

1. Draw the following crystallographic plane and the direction in a cubic unit cell
 (i) $(3\bar{2}1)$ (ii) $[\bar{1}20]$ (04 marks)
2. Name two primary bonds and two secondary bonds that present between atoms. Give one example for each type of bond. (04 marks)
3. Nickel has a Face Centered Cubic (FCC) structure and an atomic radius **0.163 nm**. Calculate the linear density of Nickel atoms in the $[110]$ (04 marks)

- (d) Sketch the band formation in an electrical conductor and in a semiconductor. (03 marks)
- (e) What are the important functions of IC packaging material? While proposing a suitable packaging material considering the functionality and ease of manufacturing, justify your answer. (04 marks)

(15 marks)

3. Reinforced concrete is an extensively used material in construction projects. The structural components were casted by embedding steel bars in concrete. With time the embeded steel bars start to corrode due to environmental conditions as shown in Figure B3. This corrosion is severe in costal areas.

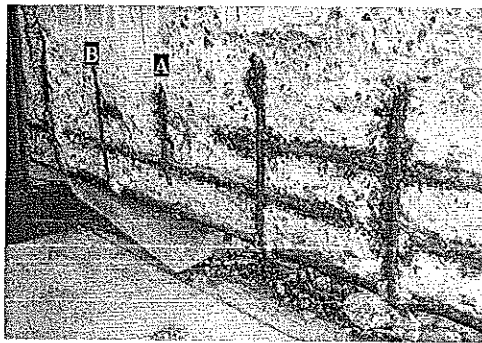


Figure B3

- (a) Rusting of steel bars can be explained as a Galvanic cell corrosion with single electrode. Write the Anodic and Cathodic reactions for this cell. (03 marks)
- (b) Write four other types of Corrosion in metallic materials and describe one of them. (04 marks)
- (c) Name three different corrosion control methods and briefly describe one of them. (04 marks)
- (d) Briefly explain how the corrosion of steel reinforcement would effect the concrete structural component. (04 marks)

(15 marks)

4. (a) What is a dislocation of a crystal? (03 marks)
- (b) Show with diagrams, an edge dislocation and a screw dislocation in crystal structure. (04 marks)
- (c) Briefly explain the "**Precepitation Hardening of Metals**" and how it is being done. (04 marks)
- (d) Describe two methods that can be use to strengthen polymers. (04 marks)
- (15 marks)**
5. (a) Differentiate between thermoplastics and thermosetting plastics. Give two examples for each type of plastics. (05 marks)
- (b) Describe the Injection Moulding process used for forming thermoplastic products. (05 marks)
- (c) What are the advantages and disadvantages of this process over other processes used fot the fabrication of thermoplastic products. (05 marks)
- (15 marks)**
6. (a) With the aid of sketches, briefly explain complete solid solubility and partial solid slubility in alloys. (03 marks)
- (b) A phase diagram of Magnesium-Lead is shown in **Figure B6.** Answer the following questions refering Figure B6. (12 marks)
- (i) Lable the phases in areas 1 - 6 and name the reaction which occurs at point E. (**Attached the phase diagram with your answer script**)
- (ii) Consdering an alloy containing **Pb-75 wt%** and **Mg-25 wt%** state the phase changes that occur when cooling from **700°C** to **0°C**.
- (iii) Calculate the amount of liquid and solid present at temperature **500°C** for the above alloy.
- (15 marks)**

7. Discuss and analyze the significance of any three of the following from an Engineering point of view.

(a) Fatigue failure occurs in materials. *(05 marks)*

(b) Invariant reactions in the Iron-Carbon diagram. *(05 marks)*

(c) Mechanical properties of materials. *(05 marks)*

(d) Metal fabrication processes. *(05 marks)*

(15 marks)

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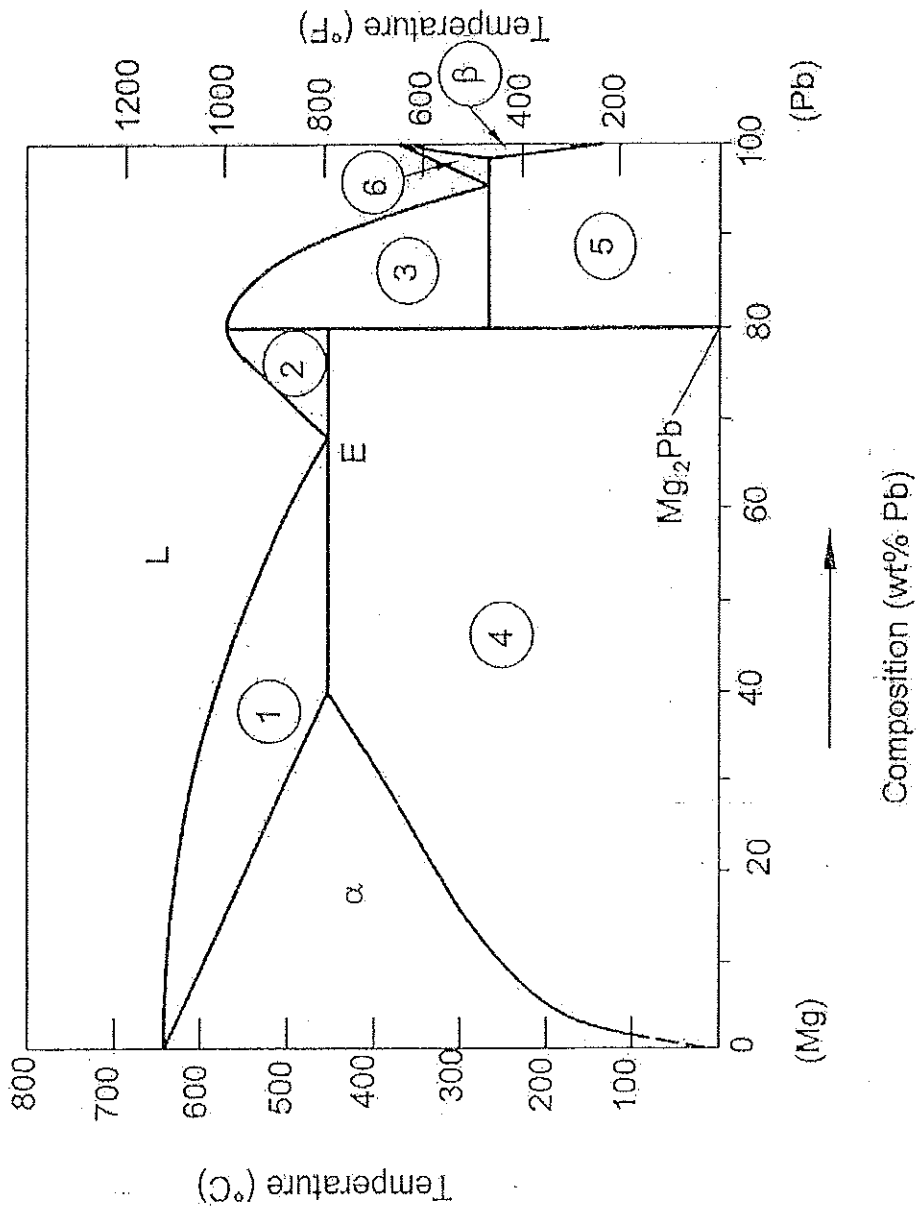


Figure B6 : The Magnesium-Lead phase diagram

