CONFIDENTIAL

UNIVERSITY COLLEGE TATI

UNIVERSITY COLLEGE TATI (UCTATI)

FINAL EXAMINATION QUESTION BOOKLET	
COURSE CODE	: BGE 2253
COURSE TITLE	: MATERIALS SCIENCE
SEMESTER/SESSION	: 2 - 2024/2025
DURATION	: 3 HOURS

Instructions:

1. This booklet contains four (4) questions. **Answer ALL questions.**
2. All answers should be written in answer booklet.
3. Write legibly and draw sketches wherever required.
4. If in doubt, raise up your hands and ask the invigilator.

DO NOT OPEN THIS BOOKLET UNTIL YOU ARE TOLD TO DO SO

THIS BOOKLET CONTAINS 7 PRINTED PAGES INCLUDING COVER PAGE

INSTRUCTION: ANSWER ALL QUESTIONS

QUESTION 1

a) In general, materials have six (6) main groups, list two (2) groups of materials. (2 Marks)

b) Solid material is constructed from the smallest entity called the atom. Draw the atom structure of the Aluminum atom which has 12 electrons. (3 Marks)

c) There are three most common crystal types in materials science such as FCC, BCC, and HCP. Sketch three unit cells of crystal structure. (6 Marks)

QUESTION 2

a) Define the corrosion of metal. (2 Marks)

b) State four (4) types of corrosion. (4 Marks)

c) Corrosion prevention techniques can be generally classified into 6 types. State four (4) types of corrosion prevention. (4 Marks)

d) Ahmad has made an experiment on a nail by using five different solutions. There has been dipping in oil, tap water, salt water, distilled water, and soap water. Classify the rate of corrosion from the most corrosive to the less corrosive. (5 Marks)

e) One student has conducted a corrosion experiment. The data are given in Table 1 below. Find the corrosion rate for each specimen and the degree of effectiveness of the inhibitor. Write down your answer in the answer script.

Table 1

Specimen	Initial weight (gram)	Final weight (gram)	Weight loss (gram)	Density (g/cm^3)	Area of the specimen (square. inch)	Exposure time (hour)	Corrosion rate
x (Specimen with inhibitor)	100	50		2.86	11	24	
y (Specimen without inhibitor)	100	35		2.86	11	24	

(7 Marks)

QUESTION 3

a) Based on Figure 1, shows Cuprum – Nickel system alloy is slowly cooled from 1400°C to 1200°C. Find:

i. The melting temperature of Cuprum. (2 Marks)

ii. The melting temperature of Nickel. (2 Marks)

iii. State the name of line a and b. (4 Marks)

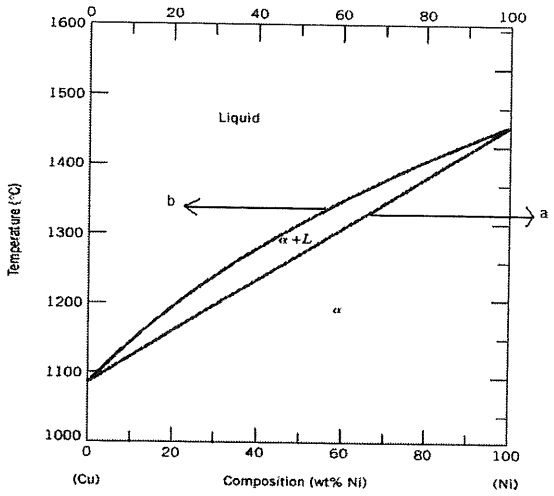

Figure 1

b) Based on Figure 2 show Pb - Sn system, find:

i. Eutectic Composition (3 Marks)

ii. Eutectic Temperature (2 Marks)

iii. Solid solubility limit of α (3 Marks)

iv. Solid solubility limit of β (3 Marks)

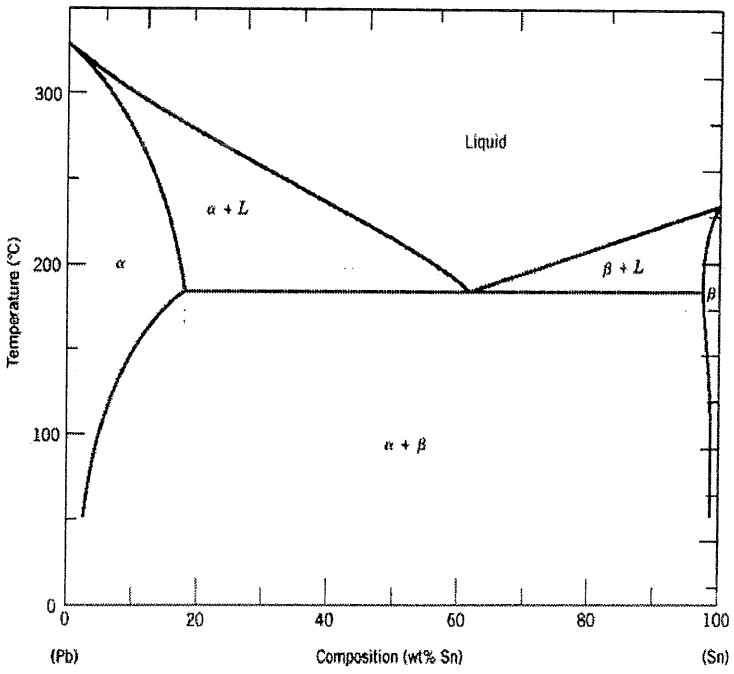

Figure 2

c) Based on Figure 3, determine:

i. Eutectic composition (3 Marks)

ii. Eutectic temperature (2 Marks)

iii. Eutectoid composition (3 Marks)

iv. Eutectoid temperature (2 Marks)

v. Peritectic composition (3 Marks)

vi. Peritectic temperature (2 Marks)

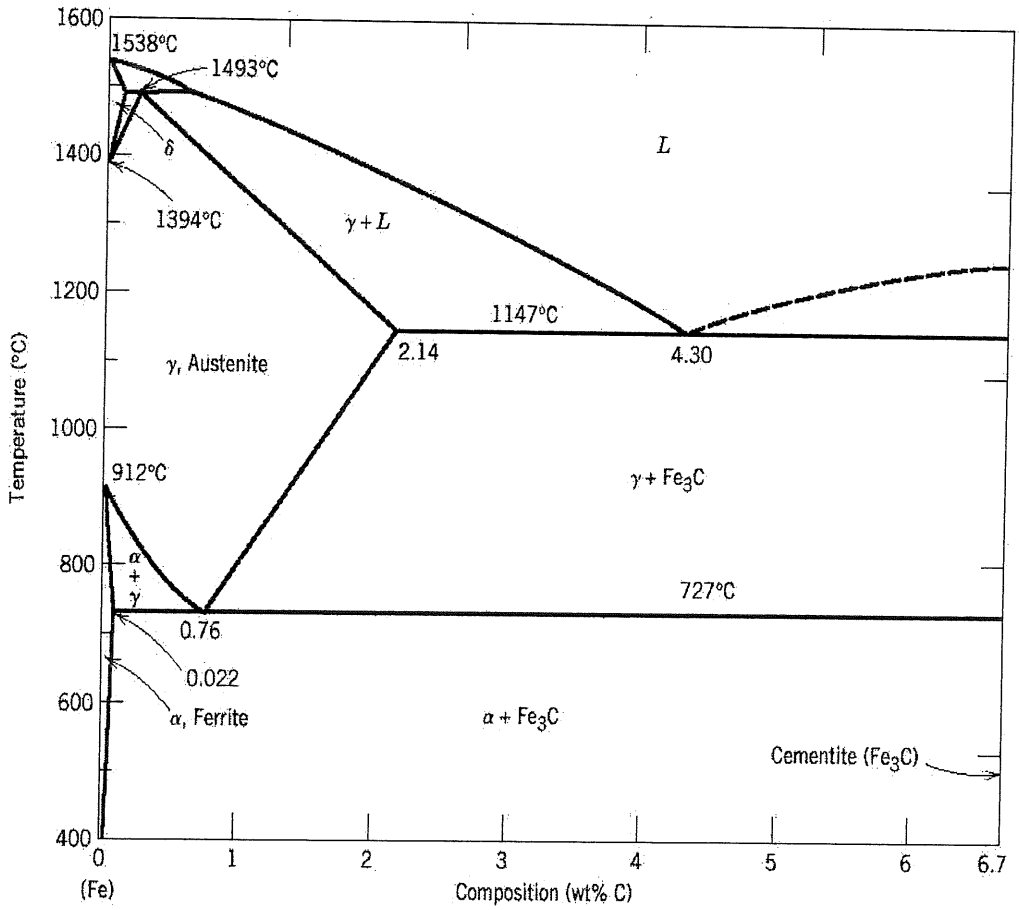

Figure 3

QUESTION 4

a) Define the following terms:

i. Stress (2 Marks)

ii. Strain (2 Marks)

iii. Young's Modulus (2 Marks)

b) The deformation of materials is divided into two types. There are plastic and elastic deformations. Describe:

i. Plastic deformation (3 Marks)

ii. Elastic deformation (3 Marks)

c) A block of gelatin is 60 mm by 60 mm by 20 mm when unstressed. A force of 0.245 N is applied tangentially to the upper surface causing a 5 mm displacement relative to the lower surface. The block is placed such that 60 mm x 60 mm comes on the lower and upper surfaces. Determine:

i. Stress (3 Marks)

ii. Strain (3 Marks)

iii. Young's Modulus (3 Marks)

d) Given the data of stress and strain values as shown in Table 2. Plot the graph stress versus strain and calculate Young's Modulus value.

Table 2

Reading	1	2	3	4	5	6	7	8	9
Stress (MPa)	100	200	300	400	500	500	400	300	200
Strain (mm/mm)	0.002	0.004	0.006	0.01	0.02	0.022	0.06	0.08	0.082

(8 Marks)

e) The stress-strain graphs for materials A and B are shown in Figure 4. The graphs are drawn to the same scale. Differentiate which one the materials has the greater Young's modulus and the stronger material.

(4 Marks)

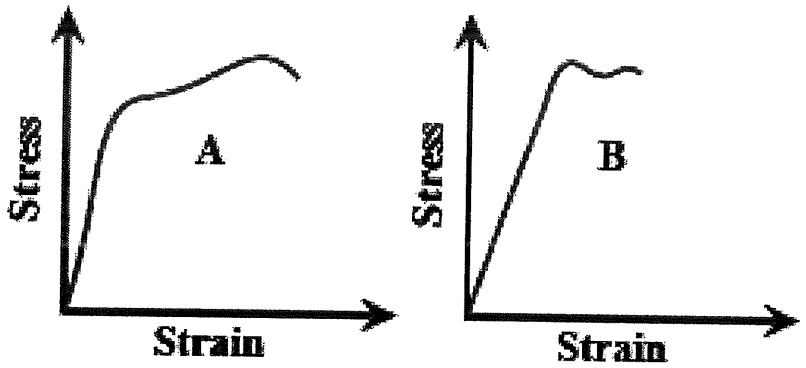

Figure 4

----------END OF QUESTIONS----------