

Name N. K. Gul

Entry No: 2021EEB1192

Course Code: SEI06



INDIAN INSTITUTE OF TECHNOLOGY ROPAR
GE106

Second Semester of Academic Year 2022- 2023

Mid-semester Examination

Duration: 2 Hours

Max. Marks: 25

Date: 11.05.2023

- Use of scientific calculator is allowed.
- No clarifications will be entertained during the examination.
- Answer to each question must start on a new page.
- Answer to all the Sections and its sub-part of a question should appear together.

Boltzmann constant $k_B = 1.38 \times 10^{-23} \text{ m}^2 \text{ kg s}^{-2} \text{ K}^{-1}$

Planck's constant $h = 6.626 \times 10^{-34} \text{ m}^2 \text{ Kg s}^{-1}$

Molar gas constant $= 8.31446262 \text{ m}^2 \text{ kg s}^{-2} \text{ K}^{-1} \text{ mol}^{-1}$

$m_e = 9.10938188 \times 10^{-31} \text{ Kg}$

$m_p = 1.672 \times 10^{-27} \text{ Kg}$

Electronic charge $= 1.6 \times 10^{-19} \text{ C}$

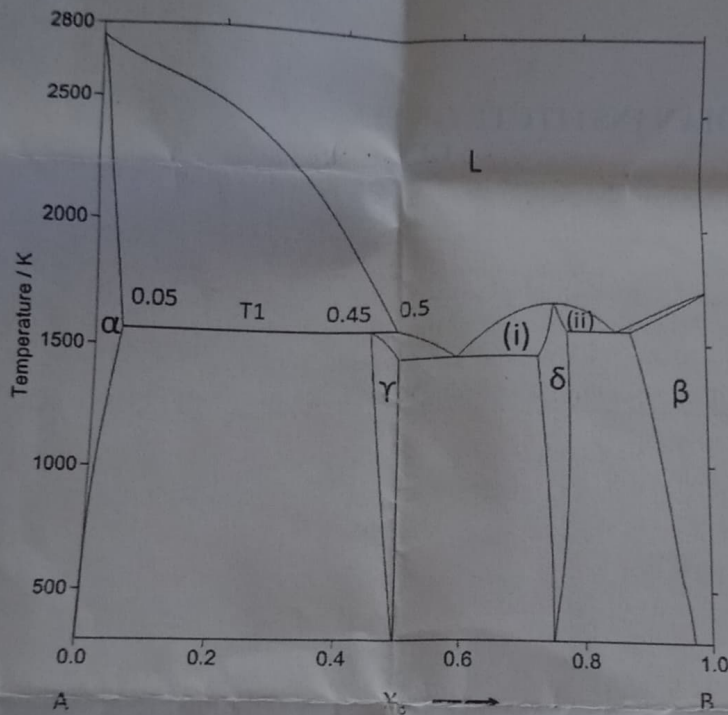
Gravitational constant $G = 6.673 \times 10^{-11} \text{ m}^2 \text{ Kg}^{-1} \text{ S}^{-2}$

Section A

1. Explain why we don't have a base-centered cubic cell. [1 mark]
2. Explain with a diagram how we can find out the burgers vector of an edge dislocation. [1 mark]
3. The diffusion coefficients for carbon in nickel are given at two temperatures: $5.5 \times 10^{-14} \text{ m}^2/\text{s}$ at 600°C and $3.9 \times 10^{-13} \text{ m}^2/\text{s}$ at 700°C . (a) Calculate D_0 and the activation energy for diffusion; (b) What is the magnitude of D at 850°C . [5 marks]
4. Consider an X-ray beam travelling in the $[110]$ direction of a cubic single crystal ($a=3.87\text{\AA}$). If (011) is the first reflection that is obtained in this setting, then determine the following: [2 + 1.5 + 1.5]
 - a. The Bragg angle
 - b. The wavelength of the X-ray beam
 - c. Miller indices of the direction of the reflected beam
5. Consider the phase diagram below: [1 + 1 + 1 + 2]
 - (a) What are the phases in the regions marked (i) and (ii)
 - (b) Which phase forms through a peritectic reaction?
 - (c) Give all the eutectic reactions in the phase diagram

- (d) For an average alloy composition of 0.2 (i.e. 80% A and 20% B) calculate the equilibrium phase fractions at a temperature 0.001°C above T_1 and at 0.001°C below T_1 .

(e)



Section B

Answer in a word or maximum one sentence

6. What is the order of conductivity in a good conductor? 1
7. What are the origins of electrical resistance in a conductor? 1
8. What is the relation between the resistivity and mobility of the charge carriers? 1

Solve the following numerical

9. Find out the velocity of electrons in a conductor, which is in thermal equilibrium at 300 K. Consider the electrons as free electrons gas. 2

10. Chromium ($3d^5 4s^1$) forms into a BCC structure with lattice parameter of $2.91 \text{ \AA}$. Find out the resistivity of the Chromium, if the mobility of the electrons in Chromium is $10 \text{ cm}^2/(\text{V.s})$. 3