KATHMANDU UNIVERSITY
End Semester Examination [C]
0 2 MAY 2023 April/May, 2023

Level : B.E. Course : MEEG 213
Year : II Semester : I
Time : 2 hrs. 30 mins. F.M. : 40

SECTION "B"
[4Q. × 10 = 40 marks]

Attempt *ALL* questions.

1. a. How do material properties depend upon bonding forces and energies? Explain with the help of suitable graphs. [1 + 1]

   b. Determine the Miller indices for the planes shown in Figure 1. [3]

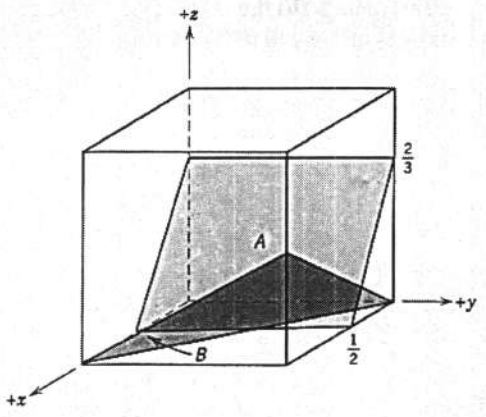

Figure 1

   c. Copper has theoretical density of 8.89 /cm^3. It has an FCC crystal structure and an atomic weight of 63.5 g/mol. Find its unit cell edge length. [2]

   d. Write three differences between metallic and ceramic materials. Provide relevant examples. [3]

2. a. Design a cylindrical riser, with a height equal to thrice its diameter, that will compensate for shrinkage in a 5 cm × 10 cm × 20 cm casting so that the riser takes 30% longer to solidify than the casting. [3]

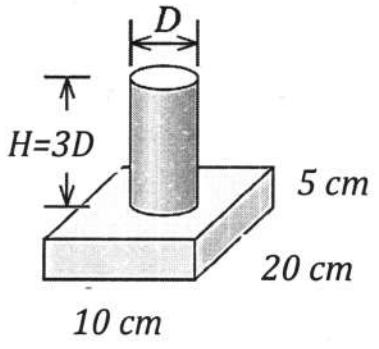

Figure 2

b. Determine: [2 + 2]

i. The fraction of total ferrite and cementite phases for a 99.65 wt. % Fe-0.35 wt. % C alloy at a temperature just below the eutectoid.

ii. Number, types and the phase amounts for 2 wt. % C at 1300°C.

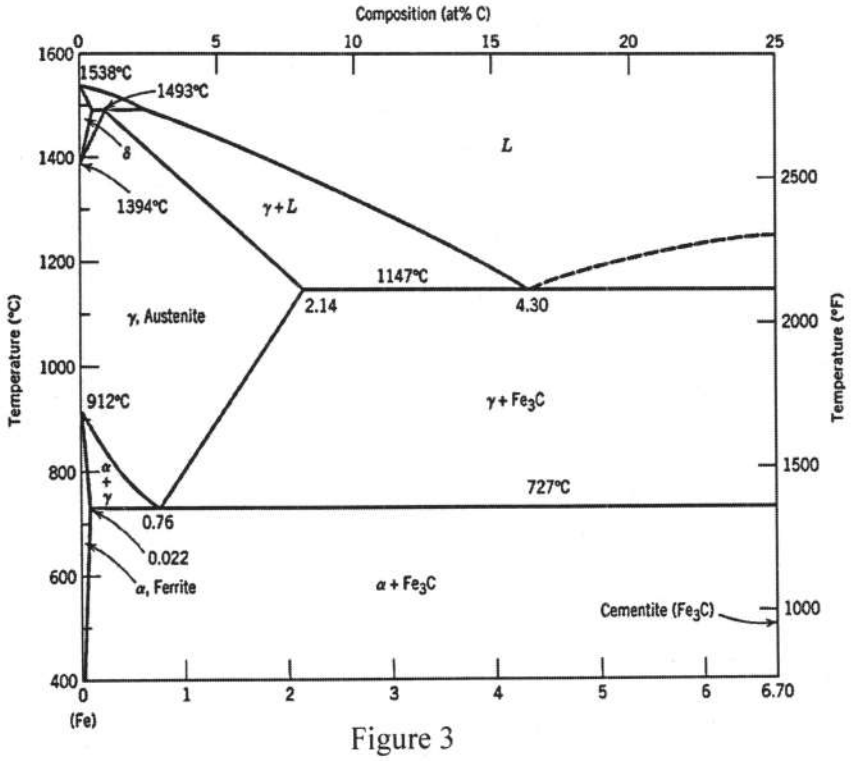

Figure 3

c. Draw TTT diagram with important demarcations. Explain how it is formed. [2 + 1]

3. a. Explain three-common types of line defects. Draw relevant figures. [2 + 1]

b. The metal rubidium has a BCC crystal structure. If the angle of diffraction for the (321) set of planes occurs at 27 degree (first order reflection) when monochromatic x-radiation having a wavelength of 0.071 nm is used, compute the interplanar spacing for this set of planes and the atomic radius for a rubidium atom. [3]

c. Apply Gibbs phase rule to find degrees of freedom for different phases and phase transformation for unary and binary systems. Interpret the results. [1 + 1]

d. Explain the process of twinning imperfection. Draw relevant figures. [1 + 1]

4. a. Explain 3 stages in fatigue occurrence in a material. Draw relevant diagrams. [1 + 1]

b. Give at least 2 precise reasons for the following: [1 + 1]

i. Aluminum-copper alloys are commonly used in casting industries.

ii. Tin is used for food packaging.

c. What is ductile to brittle transition? Explain with a suitable example. [1 + 1]

d. How are inorganic glasses formed? Explain with suitable graph. [1 + 1]

e. How is fracture toughness related to crack propagation? [2]