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UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES

End Semester Examination, December 2017

Program: B. Tech Mechanical, Mechanical (Pro, MD, The, MSNT) **Semester – III**
Subject (Course): Material Science **Max. Marks : 100**
Course Code : GNEG 232 **Duration : 3 Hrs**
No. of page/s: 02

Section A: 5 marks each (Attempt all questions)

1. Write key properties of Magnesium alloys. Discuss the composition and applications of the two main alloys of copper?
2. Discuss Hume-Rothery's rules for solid solubility.
3. Calculate the volume of the zinc crystal structure unit cell by using the following data: pure zinc had hcp crystal structure with lattice constant 'a'= 0.2665 nm and 'c' = 0.4947 nm.
4. Define Phase, solidus line, liquidus line. Write Gibb's Phase rule for unary and binary alloys.

Section B: 10 marks each (5 to 7 are mandatory, attempt either 8 or 9)

5. Discuss Griffith's theory of failure. Derive the relationship for critical stress required for crack propagation.
6. Differentiate between true and engineering stress with the help of stress vs strain curve for both.
7. Define Berger's Vector. Explain edge dislocation.
8. Explain cementite, pearlite, α-ferrite,γ-austenite, eutectoid steel.
   A 0.80 % C steel is slowly cooled from 750 °C to a temperature slightly below 723 °C. Assuming that the austenite is completely transformed to α-ferrite and cementite, calculate: a) the weight percent of ferrite formed, b) the weight percent of cementite formed.

OR

9. Sketch a completely labelled Fe-Fe_3C equilibrium diagram. Explain hypoeutectoid and hypereutectoid alloys. How pearlite is formed?

Section C: 20 marks each (10 is mandatory, attempt either 11 or 12)

10. Explain eutectic, eutectoid, peritectic and peritectoid transformation.
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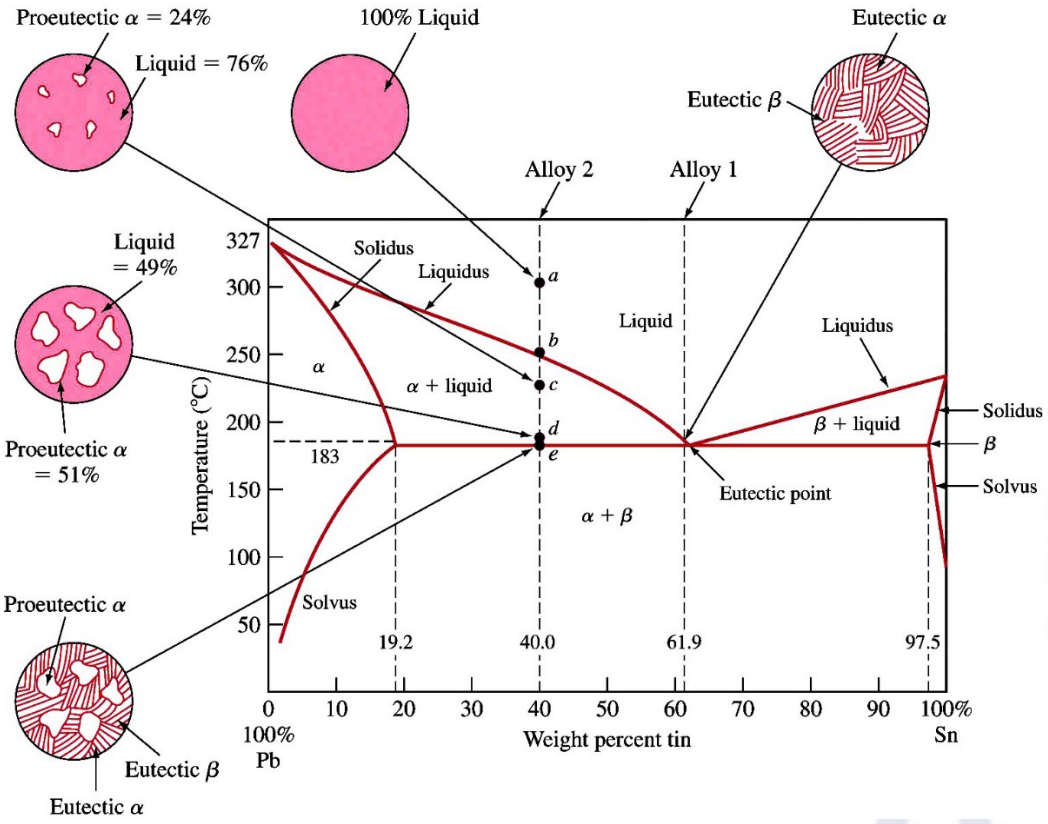
    One Kg of an alloy of 70 % Pb and 30 % Sn is slowly cooled from 300 °C. Refer to the phase diagram below and calculate the following:
    a. The weight percent of the liquid and proeutectic alpha at 250 °C.

b. The weight percent of the liquid and proeutectic alpha just above the eutectic temperature (183 °C) and weight in kilograms of these phases.

c. The weight in kilograms of alpha and beta formed by the eutectic reaction.



11. A. Describe quenching process. What is formed during quenching of eutectoid steel?
    B. How grain size depends on cooling rate and temperature?
    C. Discuss how strength of material depends on grain size.
    D. Why solubility of carbon is more in fcc iron as compared to bcc iron?

OR

12. A. Sketch completely labelled TTT curve for eutectoid steel.
    B. Explain the necessary conditions for the formation of Martensite. What is its crystal structure? Why such structure is formed?
    C. Discuss Annealing and Normalizing.
    D. What type of microstructures are obtained during annealing and normalizing of eutectoid steel?