

M/E/TX



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Vellore Institute of Technology
(Established by the Vellore Education Society in 1984)

Final Assessment Test – May 2024

Course: **BCHE206L - Materials Science and Engineering**

Class NBR(s): **1189**

Time: **Three Hours**

Slot: **C1+TC1**

Max. Marks: **100**

Reg. No: **22B CM0032**

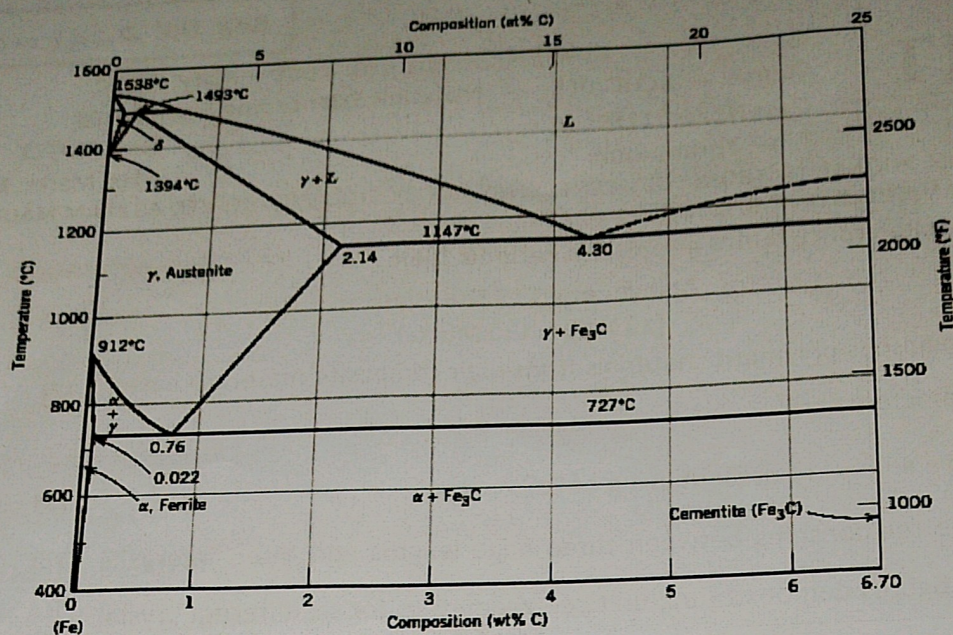
- **KEEPING MOBILE PHONE/ELECTRONIC DEVICES EVEN IN 'OFF' POSITION IS TREATED AS EXAM MALPRACTICE**
- **DON'T WRITE ANYTHING ON THE QUESTION PAPER**

General Instructions: Reference tables permitted: Periodic Table

Answer any TEN Questions

(10 X 10 = 100 Marks)

1. a) What distinguishes polymeric materials from their composite materials based on their characteristics? [7]
a) How many Fe atoms are present in 1 g of Fe? [3]
2. a) Describe the relationships between three edge lengths and three interaxial angles with figures demonstrating unit cell geometries for six different crystal systems. [6]
b) Derive planar density expressions for FCC (100) plane in terms of the atomic radius (R). [4]
3. a) Calculate the equilibrium number of vacancies per cubic meter for copper at 1000°C. The energy for vacancy formation is 0.9 eV/atom; the atomic weight and density (at 1000°C) for copper are 63.5 g/mol and 8.4 g/cm³, respectively. [7]
b) How do defects affect material properties? [3]
4. For a 99.6 wt% Fe-0.40 wt% C at a temperature just below the eutectoid, determine the following
a) composition of Fe₃C and ferrite (α)
b) the amount of carbide (cementite) in grams that forms per 100 g of steel
c) the amount of pearlite and pro eutectoid ferrite (α)



Iron-Iron Carbide Phase Diagram

5. Analyze the role of cooling on the development of different microstructures in isomorphous alloys using a suitable phase diagram. [7]
6. a) Differentiate between intrinsic and extrinsic semiconductors. [3]
b) Explain the effect of temperature on the magnetic property of a metal. [3]
7. a) A brass rod is to be used with its end held rigid. What is the maximum temperature at which the rod can be heated to without the compressive stress in it exceeding 172 MPa. Elastic modulus of brass $E=100$ GPa and $\alpha_L = 20 \times 10^{-6} \text{ } ^\circ\text{C}^{-1}$. [6]
b) Explain the degradation mechanism for metal and polymer-based materials. [4]
8. For BCC iron, compute (a) the interplanar spacing and (b) the diffraction angle for the (220) set of planes. The lattice parameter for Fe is 0.2866 nm. Assume that monochromatic radiation with a wavelength of 0.1790 nm is used, and the reflection order is 1. [7]
9. a) Illustrate the method to determine the depth of field in the Scanning Electron Microscope (SEM). [3]
b) Differentiate amongst the Scanning Electron Microscope, Transmission Electron Microscope, and Scanning Transmission Electron Microscope. Also identify their application. [7]
10. a) Identify the fire and explosion hazards associated with hydrogen fuel cells. Give your recommendation for resolving those issues. [6]
b) Differentiate between Proton Exchange Membrane Fuel Cell (PEMFC), Solid Oxide Fuel Cell (SOFC), and Direct Methanol Fuel Cell (DMFC). [4]

11. a) What are the advantages of using a cold wall reactor vs a hot wall reactor in performing the chemical vapor deposition process? [5]
- b) What are the main differences amongst normalizing, full annealing, and spheroidizing annealing? [5]
12. a) Compare different thin film deposition techniques from the point of view of substrate temperature, cost, purity, grain size, and deposition rate. [5]
- b) Distinguish between the Top-down and Bottom-up approaches of the nanoparticle synthesis method. [5]

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