KATHMANDU UNIVERSITY
End Semester Examination [C]
May/June, 2019

Marks scored:

Level: B.E.
Year : II

Course : MEEG 213
Semester : I

Exam Roll No. :

Time: 30 mins.

F. M. : 10

Registration No. :

Date 31 MAY 2019

SECTION "A"
[20 Q. × 0.5 = 10 marks]

Choose and mark [X] the most appropriate answer.

1. Carbon-epoxy belongs to which category of material.
[ ] Metals [ ] Polymers [ ] Composites [ ] Ceramics

2. Metallic glasses are _____.
[ ] liquid crystals [ ] amorphous metals [ ] single crystals [ ] glass ceramics

3. The highest relative length of stream in spark test is seen in _____.
[ ] wrought iron [ ] white cast iron [ ] high speed steel [ ] aluminum

4. Packing factor of hexagonal close packed crystal structure is _____.
[ ] 0.74 [ ] 0.68 [ ] 1 [ ] 0.52

5. Molar mass of silver is 107.868 g/mol and Avogadro's number, $N_a = 6.023 \times 10^{23}$ /mol. Calculate the number of atoms in 100 g of silver.
[ ] 6.02×10^{23} atoms [ ] 7.05×10^{23} atoms
[ ] 5.95×10^{23} atoms [ ] 5.58×10^{23} atoms

6. Which of this iron form exhibit non-magnetic properties?
[ ] pearlite [ ] ferrite [ ] austenite [ ] martensite

7. The correct order of coordination numbers for SC, BCC and FCC unit cells are:
[ ] 6, 8, 12 [ ] 8, 8, 12 [ ] 6, 6, 12 [ ] 8, 12, 12

8. In which type of point defect, positive and negative ions are missing from the crystal arrangement?
[ ] vacency [ ] interstitial [ ] substitutional [ ] schottky

9. _____ is defined as a shear deformation that moves atoms by many interatomic distances in one crystal plane over the atoms of another crystal plane.
[ ] Slip [ ] Twinning [ ] Dislocation [ ] Shear stress

10. Formation of micro-voids in the failed material indicates_____.
[ ] ductile fracture [ ] brittle fracture
[ ] fatigue fracture [ ] corrosion failure

11. Binary phase diagrams of two component systems are usually
[ ] two dimensional plots of temperature and pressure
[ ] two dimensional plots of temperature and composition
[ ] two dimensional plots of pressure and composition
[ ] two dimensional plots of pressure, temperature and composition

12. If P is the number of phases, F is the degree of freedom, and C is the number of components in a system, then, the Gibbs phase rule at constant atmospheric pressure is given by
[ ] $1 + C = P + F$ [ ] $1 - C = P + F$ [ ] $2 + C = P + F$ [ ] $2 - C = P + F$

13. Vickers hardness tester uses _____ indenter geometry.
[ ] spherical [ ] diamond [ ] conical [ ] rhombic

14. Which of the following is not a solidification defect in metal casting?
[ ] shrinkage cavity [ ] columnar grains
[ ] interdendritic shrinkage [ ] gas porosity

15. Which of the following is not true about dispersion strengthening?
[ ] dispersed phase particles should be round
[ ] hard dispersed phase should be continuous
[ ] dispersed phase particles should be small and numerous
[ ] higher concentrations of the dispersed phase increase the strength

16. A three-phase reaction in which two solids transforms to one solid on cooling
[ ] peritectic [ ] eutectic [ ] peritectoid [ ] eutectoid

17. Steel containing 0.15 to 0.3 % wt. carbon is _____.
[ ] low carbon steel [ ] mild steel
[ ] high carbon steel [ ] stainless steel

18. Which among the following is least ductile?
[ ] bainite [ ] fine pearlite
[ ] spheroidite [ ] course pearlite

19. Galvanization is done with as thin layer of _____.
[ ] copper [ ] tin [ ] zinc [ ] aluminum

20. The main alloying elements in bronze are _____.
[ ] copper and zinc [ ] zinc and tin
[ ] copper and tin [ ] copper and iron

KATHMANDU UNIVERSITY
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31 MAY 2019

Level: B.E.
Year : II
Time: 2 hrs. 30 mins.

Course : MEEG 213
Semester : I
F. M. : 40

SECTION "B"
[40 marks]

Attempt ALL the questions. Assume suitable data if necessary.

1.

a. How is materials science different to material engineering? [1]

b. Give one application of each of the materials: Ceramics, Polymers, Composites. And state two major properties of each of the materials to explain the choice of materials for the stated applications. [3]

c. Write short notes on [3 × 1 = 3]
i) Brass alloy, ii) Metallic glass and iii) Glass ceramics.

2.

a. State the differences between crystalline and amorphous materials with suitable examples. [2]

b. Iron changes from BCC to FCC metal structure at 912 °C (1673 °F). At this temperature, the atomic radii of the iron atoms in the two structures are 0.126 nm and 0.129 nm, respectively. What is the percentage volume change, as the structure changes? [2]

c. Indicate the crystallographic direction [111] and plane (111) in crystal structure. [1]

d. What do you understand by dislocation? Explain different types of dislocation defects observed in crystalline materials. [3]

3.

a. A 212 cm copper wire is 0.76 mm in diameter. Plastic deformation started when the load was 8.7 kg.
i. What was the force provided in N? [1]

ii. When loaded to 15.2 kg, the total strain was 0.011. the wire was then unloaded. What is the length of the wire after unloading? [2]

iii. What is the yield strength of the copper? [1]

b. Define impact load with example. Explain the properties that can be obtained in impact testing. [3]

c. Describe the fatigue failure observed in metallic materials. [2]

4.

a. Pure water could be undercooled to as low as -40° C without forming ice. However, when the undercooled water is jerked or come in contact with an ice crystal, it rapidly transforms into ice. Explain the reason behind such behavior. [1]

b. Explain planar and dendritic growth mechanisms observed in solidification process. Illustrate the heat transfer observed at the interface in each growth mechanisms. [3]

c. What do you understand by solid solution? Explain with suitable examples why solid solution strengthened alloys gain higher strength than pure metals. [3]

5.

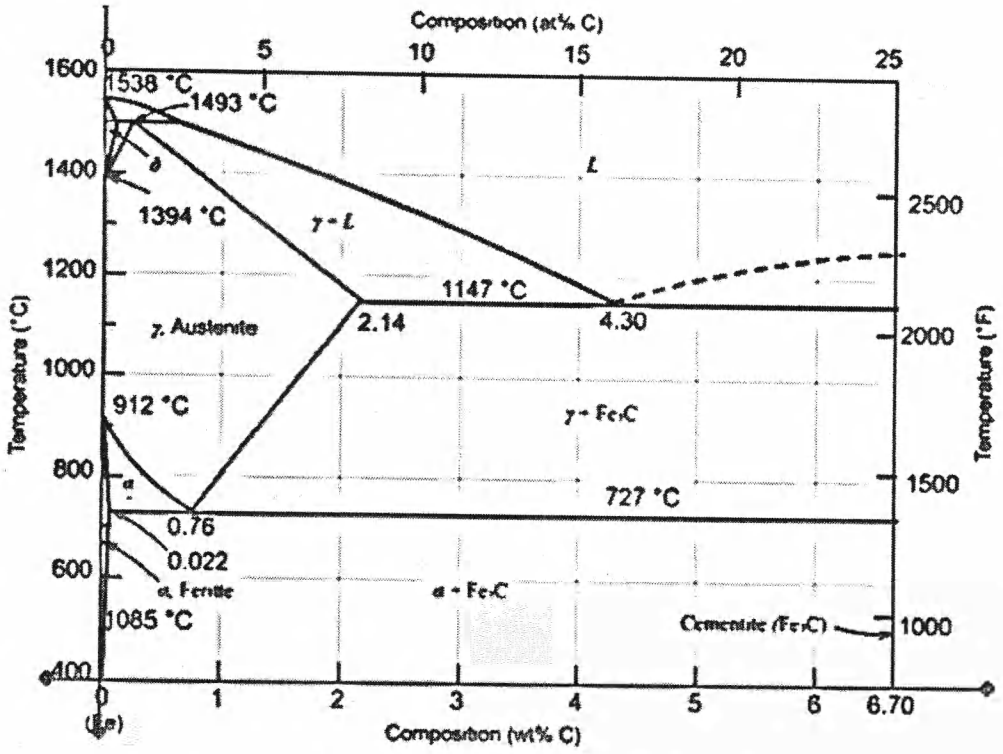

Figure 1: Iron – Iron carbide phase diagram

a. In the binary phase diagram presented in Figure 1, state the type of invariant reaction occurring at 0.76 % wt. C and 727 °C. Use Gibbs phase rule to evaluate DOF at the stated point in the phase diagram. Calculate the amounts of ferrite and cementite present in pearlite at the stated point. [3]

b. Based on Figure 1, describe full annealing and normalizing heat treatment processes explaining the expected microstructures at the end of the heat treatment processes. [2]

c. What do you understand by martensite in steels? Which heat treatment process is suitable to enhance ductility in martensitic steel and why? [2]

d. Define the terms: [4 × 0.5 = 2]

i. Intermetallic compound
ii. Solidus
iii. Solvus
iv. Carburizing