Ref. No. : Ex/Met/T/223/2018

B.E. METALLURGICAL AND MATERIAL ENGINEERING SECOND YEAR SECOND SEMESTER - 2018

Subject : MATERIAL SCIENCE

Time: Three Hours **Full marks: 100**

(Answer Question No. 1 and any four from the rest; All parts of a question should be answered in one place)

Q1. a) What is a crystal?
b) How does a crystal differ from a lattice?
c) What are the parameters required to define a crystal system?
d) How can you sort out a crystalline structure from a non-crystalline structure?
e) What do you mean by lattice correspondence? – explain with an example.
f) How does a polycrystal form from a liquid melt? 2+2+2+4+5+5 = 20

Q2. a) What is phase?
b) Define Gibbs Phase Rule?
c) What do you mean by condensed matter system?
d) What is known as invariant reaction? Give an example of invariant reaction.
e) What is the similarity and dissimilarity between a pure system and a solution?
f) How does a solution differ from a mixture? Explain
g) In what respect does a polycrystal vary from single crystal? 3+3+2+3+4+3+2 = 20

Q3. a) What is meant by solid solution?
b) What are different types of solid solution? After giving examples highlight the difference between different types of solid solution.
c) What is meant by "random" solid solution?
d) State the Hume-Rothery rules for the formation of extensive solid solution.
e) What is an "ordered structure"? Give two examples of "ordered structure".
f) What is electron compound? 2+4+2+5+4+3 = 20

Q4. a) Write a note on metallic bonding.
b) Make a Comparative discussion about the strength of metallic bond and covalent bond.
c) Discuss the structure of graphite and its electrical properties. 7+8+5 = 20

Q5. a) Draw the Fe-C phase diagram with proper labelling of phases, temperature and composition.
b) How will you define Ac_1 and Ac_3 lines in Fe-C phase diagram?
c) Write down the Peritectic reaction in Fe-C system? What is the degree of freedom of this reaction? Why the reaction does not go to completion? 10+3+2+2+3 = 20

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Q6. a) How will you find the Miller indices of any crystal plane?

b) Determine the Miller indices of close packed planes of an FCC crystal.

c) What are different types of interstitial voids present in a crystal and how do these voids form in close packed structure?

d) What is the reason for very low solubility of carbon in ferrite the in austenite?

e) Find the packing efficiency of diamond. 3+4+6+4+3 = 20

Q7. a) What is ledeburite? Write down the reaction following which ledeburite forms. Find the amount of the phases present in ledeburite. 2+2+4 = 8

b) Draw a binary phase diagram of A and B where one component (A) is completely immiscible in the other in the solid state, but the other component (B) is partly miscible in the solid state; and both the components have complete liquid solubility. 5

c) Write down the eutectoid reaction in Fe-C system and find the degree of freedom of this reaction. Find the amount of different phases at room temperature in case of a system containing 0.5 wtpct carbon in iron. 2+2+3 = 7