

Ref. No. : Ex/Met/T/ 223/2017

B.E. Metallurgical & Material Engineering 2nd Year 2nd Semester Exam - 2017

Subject: Materials Science

Time: 3 hours

Full marks: 100

Attempt Q. no. 1 and any four (4) from the rest

4×5

- 1).
 - i) Calculate the c/a ratio for an ideally close packed HCP crystal.
 - ii). Draw a (110) and a $(\bar{1}\bar{1}0)$ plane inside a cubic unit cell. Determine the miller indices of the direction that is common to both these planes.
 - iii). Find the family of crystal directions represented by cubic edges, face diagonals and body diagonals of the cubic unit cell . Give the number of members in each family.
 - iv). Calculate the planar density of (0001) plane.
 - v). Define Interplanar Spacing with example.

10+10

2.
 - a). Discuss the Structure – Property relationship of the material
 - b). Describe the electronic structure of the atom.

10+10

3.
 - a). What is solid solution ? State the Hume-Rothery conditions for extensive solid solutions and justify the conditions with example.
 - b). Find the size of the largest sphere that will fit an interstitial void in a BCC crystal as a function of the atomic radius r . The void is located at $(\frac{1}{2}\ \frac{1}{4}\ 0)$.

10+10

4. a). Write the importance of a phase diagram.
- b). The phase diagram of a binary system of A and B has a three phase equilibrium at 250 °C with the composition of α , liquid and β phases equal to 10%, 55% and 95% B. Just below 250°C, find the composition at which the proeutectic phase is 1.5 times the eutectic mixture.

10+10

5. a). Describe the phase changes that take place on cooling for a 3.0% C in the Fe-C system.
- b). From the Fe-C diagram, What is the fraction of proeutectoid phase, phases that part of the eutectoid mixture and total phases in a (i) 1.4% C, (ii) 1.0%C and (iii) 0.7%C steels?

10+10

6. a). Draw the following planes and directions:
- i). a $(\bar{1} \ 2 \ \bar{1} \ 0)$ plane in a HCP unit cell.
- ii). a $(1 \ \bar{2} \ 0)$ plane in a tetragonal unit cell.
- iii). $(0 \ \bar{1} \ \bar{2})$ plane in an orthorhombic unit cell.
- iv). $[\bar{1} \ 1 \ \bar{2}]$ direction in a cubic unit cell.
- v). $[2 \ \bar{1} \ \bar{1} \ 0]$ direction in a HCP unit cell
- b). Write the several important aspects of the Miller indices for both planes and directions.

7. Short notes on: 10x2

- i). Interstitial sites
- ii). Invariant reactions