(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 4068 Roll No. | | | | | | | | | | |

B.Tech.

THIRD SEMESTER EXAMINATION, 2006 - 07

MATERIAL SCIENCE

Time : 3 Hours *Total Marks : 100*

Note : *(i) Attempt ALL questions.*

(ii) All questions carry equal marks.

(iii) In case of numerical problems assume data wherever not provided.

(iv) Be precise in your answer.

1. Attempt the following :

(a) Differentiate clearly between : **(2x5=10)**

(i) Isotopes and isotones,

(ii) B.C.C. and F.C.C.,

(iii) Steel and Cast iron,

(iv) Paramagnetism and Diamagnetism,

(v) Nuclear fission and nuclear fusion.

(b) Answer *any two* following : **(5x2=10)**

(i) What is an edge dislocation ? How does it differ from screw dislocation ?

(ii) What is Bragg's law of X-ray diffraction ? X-rays with a wavelength of 0.58 Å are used for calculating d_{200} spacing in Nickel crystal. The first order reflection angle is 9.5°. What is the size of the unit cell ?

(iii) (a) An atom of a certain element has 3 electrons in the p sub - shell of its outermost main shell, which is the N shell. What is the atomic number of the element, and how many valence electrons does this element have ?

(b) How does ionic bond differ from metallic bond ? Explain in brief.

2. Attempt *any four* parts of the following : **(5x4=20)**

(a) What is critical resolved shear stress ? A stress of 80 M Pa is applied in the [001] direction of a FCC single crystal. Calculate the resolved shear stress acting on (111) $[\bar{1}01]$ slip system.

(b) The melting point of lead is 327°C and that of tin is 232°C. They form eutectic of 62% tin and 38% lead at 183°C. At eutectic temperature, maximum solid solubility of tin in lead is 19% and lead in tin is 3% which decrease to zero percent at 0°C. Assuming liquidus, solidus and solvus lines to be straight, draw phase diagram to the scale and label all areas. Also, explain solidification of 30% tin and 70% lead alloy.

(c) How does yielding occur in metallic materials ? Explain the role of dislocations in plastic deformation. What do you understand by strain hardening ?

(d) What is fatigue ? How can fatigue limit of a material be obtained ? Explain in brief.

(e) What are the different stages of creep deformation ? Explain mechanisms involved in creep. Also mention situations where creep is important.

(f) Draw a neat sketch of Iron-carbon equilibrium diagram and label it. Also sketch the microstructure of mild steel and mention its constituent grains.

3. Attempt *any four* parts of the following : **(5x4=20)**

(a) Draw a neat sketch of TTT diagram for eutectoid steel and label the regions. Explain significance of the critical cooling rate.

(b) Differentiate between :

(i) Brass and Bronze,

(ii) Pearlite and Bainite.

(c) Write short notes on *any two* of the following :

(i) High speed steel,

(ii) Duralumin,

(iii) Stainless steel.

(d) What is annealing ? How does it differ from normalizing ?

(e) Classify various types of carbon steel and mention its properties and applications.

(f) Comment on structures, properties and uses of gray cast iron.

4. Attempt *any two* parts of the following : **(10x2=20)**

(a) Discuss the phenomenon of domain theory. Steel is ferromagnetic but is not a magnet in absence of magnetic field. Explain, why. Draw and explain a typical hysteresis-curve.

(b) Differentiate between conductor, semiconductor and insulator on the basis of energy band theory. How does n-type semiconductor differ from p-type semiconductor ? Explain how p-n junction is used as rectifier.

(c) Explain briefly superconductivity and Meissner effect. Differentiate between ideal superconductors and hard superconductors (or Type I & Type II).

5. Attempt *any four* parts of the following : **(5x4=20)**

(a) Composites and its uses,

(b) Ceramics and its uses,

(c) Corrosion prevention,

(d) Thermoplastics,

(e) Griffith's theory of brittle fracture,

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