

Printed Pages – 4

TME – 301

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

PAPER ID : 4068

Roll No.

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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.

TME – 301

1

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(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 \AA 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 : (5×4=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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