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Printed Pages—4 **TME—301**

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

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

B.Tech.

THIRD SEMESTER EXAMINATION, 2005-2006

MATERIAL SCIENCE

Time : 3 Hours *Total Marks : 100*

Note : *(i) Answer 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. (a) Answer the following : **(2x5=10)**

(i) Write the material for :
  (a) Lathe bed.
  (b) Filament of electric bulb.

(ii) Write major constituent elements of following alloys :
  (a) Stainless Steel.
  (b) Soft Solder.

(iii) Differentiate between :
  (a) Peritectic and Eutectoid reactions.
  (b) Solid solution and compound.

(iv) Write electronic configuration of following elements :
  (a) K, atomic number (19).
  (b) Mo, atomic number (42).

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(v) Draw the following plane and direction in a cubic unit cell :

(a) $(1\bar{1}0)$. (b) $[11\bar{1}]$.

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

(i) What is bond energy ? What are the typical properties of metals that arise from the nature of their bonding ?

(ii) Derive Bragg's equation. An X-ray beam of 0.58 Å wavelength is incident on a crystal at glancing angle of 9.5° when first order diffraction occurs. Determine the glancing angle for third order diffraction and the inter-planer spacing of the crystal.

(iii) Explain ***any two*** of the following :

(a) Edge dislocation.

(b) Twin boundary.

(c) Schottky's defect.

2. Answer ***any four*** parts of the following : **(4x5=20)**

(a) What is hardness ? What is the purpose of miner load used in the Rockwell hardness test ? How does the Rockwell hardness test differ from the Brinell hardness test ?

(b) Explain on an atomic basis why slip takes place easily in ductile materials and not in brittle materials.

(c) What are the different factors, which govern the formation of substitutional solid solutions ? Discuss them in brief.

(d) Draw Iron-Iron carbide equilibrium diagram and mark on it all salient temperature and composition fields. Also, describe the changes that take place in a plain carbon steel containing 0.6%C when cooled from 1600° to room temperature.

(e) What is Gibb's phase rule ? Show that in metallurgical systems the number of phases can not exceed the number of component plus one. Also, show that in a Binary system of alloys not more than three phases may be in equilibrium.

(f) Define the terms fatigue life and fatigue strength. Discuss the effects of surface finish and stress concentration on fatigue strength.

3. Answer *any four* parts of the following : (4x5=20)

(a) How is TTT diagram obtained ? What is its importance ?

(b) Differentiate briefly between :

(i) Austenite and martensite.

(ii) Ferrite and pearlite.

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

(i) Gun metal.

(ii) Duralumin.

(iii) Babbitt metal.

(d) Why are steels heat treated ? State the process of tempering.

(e) Briefly describe the process for making steel.

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

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

(a) Briefly describe the phenomenon of magnetic hysteresis, and why it occurs for ferromagnetic and ferromagnetic materials. Discuss coercive force and retentivity with the help of B-H curve.

(b) What is meant by superconductivity ? Explain briefly the Bardeen, Cooper and Schriefter (BCS) theory for superconductivity.

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

(i) Semiconductors.

(ii) Thermistors.

(iii) Importance of diffusion.

5. Answer *any four* parts of the following : **(4x5=20)**

(a) What are ceramics ? Explain the structures of ceramic materials.

(b) Why does a zinc coating give better protection to steel than a copper coating ?

(c) How do thermoplastics differ from thermosetting plastics ? Give their properties and industrial applications.

(d) Why are composites becoming more popular in replacing metals in many industrial applications ? Give reasons.

(e) Derive the expression for Griffith's criterion for crack propagation. Is this a necessary and sufficient condition for crack propagation in brittle fracture ? Explain.

(f) Under what different conditions a ductile material may behave in brittle manner ? What is the importance of ductile-brittle transition temperature for cryogenic applications of materials ?

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