Instructions: (1) All questions are compulsory.
(2) Answer each next main question on a new page.
(3) Illustrate your answers with neat sketches whenever necessary.
(4) Figures to the right indicate full marks.
(5) Assume suitable data, if necessary.
(6) Use of Non-programmable Electronic Pocket Calculator is permissible.
(7) Mobile Phone, Pager and any other Electronic Communication devices are not permissible in Examination Hall.

1. Solve any ten:
   a) State any two uses of OHNS.
   b) State any two applications of low carbon steels.
   c) Give any two uses of gray cast iron.
   d) State any two uses of Duralumin.
   e) State any two applications of aluminium bronzes.
   f) Classify metallic materials.
   g) State any two advantages of non-ferrous materials over ferrous materials.
   h) Define ductility and brittleness.
   i) State any two purposes of heat treatment.
   j) Classify annealing depending upon specific purpose.
   k) What is hardening? Write any two quenching media.
   l) State any four mechanical properties of an engineering metal.
   m) State any two types of case hardening methods involving thermo-chemical treatment.
   n) Classify cast irons on the basis of form of carbon present in them.

Marks

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P.T.O.
2. Solve any two:
   a) Define following phases:
      i) Cementite
      ii) Austenite
      iii) Ferrite
      iv) Martensite.
      Also state associated crystal structures for above mentioned phases.
   b) i) Define phase. What do you mean by a phase diagram?
      ii) Draw a neat labelled sketch of phase diagram for an isomorphous alloy.
   c) Draw the iron-carbon equilibrium diagram and label all the phases. Also, represent
      (i) Key temperatures, (ii) Phase reactions and (iii) Composite microstructures on it.

3. Solve any four:
   a) Why is tungsten so-important as a constituent of High Speed Steels (HSS)?
   b) Differentiate between:
      i) Bainite and Pearlite based on mechanical properties of (a) strength (b) ductility.
      ii) Fine pearlite and coarse pearlite based on mechanical properties of (a) hardness
          (b) ductility.
   c) Which stainless steel is best suited for surgical instruments? Explain.
   d) What is carburizing? How it is done?
   e) State any four benefits of annealing.
   f) What are the principal advantages of austempering compared with the conventional quench
      and temper method?

4. Solve any two:
   a) i) Sketch an Isothermal-Transformation (I-T) diagram for an eutectoid (0.8% C) plain carbon
      steel; and
      ii) a) Show a cooling curve that will result in a structure of 100 percent martensite;
          b) Show a critical cooling curve.
   b) i) Draw unit cells of following crystal structures:
      a) Face-centered cubic.
      b) Body-centered cubic.
      ii) Calculate packing efficiency for FCC crystal structure.
5. Solve any four:
   a) State any four characteristics of aluminium alloys.
   b) State any two examples of following classes of composite materials:
      i) Laminated
      ii) Fiber-reinforced.
   c) State any four differences between a thermoplastic and a thermosetting material.
   d) List different types of rubber.
   e) Draw flowchart for different types of heat treatment processes.
   f) State the chemical composition for following steels:
      i) 40 Cr 4 Mo 3
      ii) 40 Cr 8
      iii) 20 Cr 18 Ni 2
      iv) X 20 Cr 18 Ni 2.

6. Solve any four:
   a) Give any two uses for following polymeric materials:
      i) Phenol formaldehyde
      ii) Bakelite.
   b) Describe the application of powder metallurgy for the manufacturing of porous bearings.
   c) Explain the technique of powder metallurgy.
   d) Which nondestructive testing method is best suited to following situations?
      i) To determine the wall thickness at the bottom of a steel tank.
      ii) To sort out bars of mixed steel.
   e) State any four characteristics of unalloyed copper.
   f) State any four desirable properties of bearing materials.