**R13**

# JAWAHARLAL NEHRU TECHNOLOGICAL UNIVERSITY HYDERABAD
## B.Tech II Year I Semester Examinations, November - 2015
## METALLURGY AND MATERIALS SCIENCE
### (Common to ME, MCT, AME)

Time: 3 Hours

Max. Marks: 75

**Note:** This question paper contains two parts A and B.
Part A is compulsory which carries 25 marks. Answer all questions in Part A.
Part B consists of 5 Units. Answer any one full question from each unit.
Each question carries 10 marks and may have a, b, c as sub questions.

## Part- A                                          [25 Marks]

1.a) Define the term composite material. What are natural composites? Give examples.                                                              [2M]

b) Calculate the effective number of atoms in the HCP unit cell. Describe the basis for generating the HCP structure starting from the hexagonal space lattice.   [3M]

c) What is lever rule?                                                [2M]

d) What is annealing?                                                 [3M]

e) What is carbon equivalent?                                         [2M]

f) Give reasons for extremely high hardness of martensite.           [3M]

g) What is temper- embrittlement phenomena?                          [2M]

h) What is ASTM-grain size number? And what is its importance?        [3M]

i) What are the limitations of plain carbon steels?                  [2M]

j) What is the effect of cobalt addition on hardenability?           [3M]

## Part-B                                          [50 Marks]

2.a) Discuss the necessity of alloying.

b) Determine the relationship between atomic radius and lattice parameter for FCC crystals. Find the lattice parameter and atomic structure for Al (FCC) having density 2700kg/Cm$^3$ and atomic weight of Al is 26.98.

c) Distinguish between intermetallic compound and interstitial compound.   [3+4+3]

**OR**

3.a) What is the role of grain size on the properties of a material?

b) Discuss briefly the Hume-Rothery rules.

c) Distinguish between Interstitial solution and substitutional solution.       [3+4+3]

4.a) Two elements A and B are completely soluble in the liquid state and are completely in soluble in the solid state. Their healthy temperatures are 700 and 400°C respectively they form an eutectic at A-70B at 250°C. Draw the phase diagrams label various phases and temperatures.

b) Discuss the phases present, their volumes and concentration at any two temperatures for the alloy 70A-30B.                                          [5+5]

**OR**

5.a) Give the number of variables and the degree of freedom at the eutectic temperature of a binary phase diagram.

b) What is Tie-line rule?

c) What is coring and how it can be minimised.                             [4+3+3]

6.a) Compare the characteristics of nucleation growth transformation of austenite with that of a diffusion less transformation.
  b) What is retained Austenite and how it can be minimized?                    [5+5]

**OR**

7.a) What is the effect of alloying elements on:
  i) Eutectiod temperature
  ii) Eutectiod composition
  iii) Critical cooling rate
  iv) Formation of carbide
  v) Austenite phase region
  vi) Gas content
  vii) Intermediate phases formed in steel.
  b) What is spheroidizing Annealing and Normalising?                           [5+5]

8.a) Why hardening and tempering heat treatment is not practiced to a non –ferrous metals like aluminium?
  b) Explain how duralumin is strengthened.
  c) Explain how malleable iron is produced by heat treatment.                  [3+4+3]

**OR**

9.  Write explanatory notes on:
  a) Titanium and its alloys
  b) Al-Cu phase diagrams
  c) Gray cast iron and nodular cast iron.                                       [3+4+3]

10.  Enumerate the characteristics, properties and applications of cermets, glasses. [10]

**OR**

11.  Enumerate the characteristics, properties and applications of composites and polymers.                                                                        [10]

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