

***B.Tech. Degree IV Semester Examination in  
Mechanical Engineering, July 2001***

**ME 402 METALLURGY AND MATERIAL SCIENCE**

*Time: 3 Hours*

*Max. Marks: 100*

*(All questions carry equal marks)*

- I a) Distinguish between primary and secondary bonds. Explain why water has high freezing point and boiling point as compared with substance of similar molecular mass such as ammonia.
- b) Why do metallic crystals generally have irregular boundaries? Show certain mechanical properties of cast metals can be explained by reference to dendritic solidification type crystal structure.

**OR**

- II a) Draw (1 1 0) and (1 1 1) planes, and [1 1 0] and [1 1 1] directions in a simple cubic crystal. And explain in detail the forest of dislocations.
- b) Explain the concept of driving force for diffusion, cite the reasons why interstitial diffusion is normally more rapid than vacancy diffusion.
- III a) Describe the allotropic transformations in iron and discuss its beauty in practical applications.
- b) What do you understand by a solid solution? Explain with neat sketch; describe HumeRothery's rules.

**OR**

IV Explain the importance of equilibrium diagrams in the development of new alloys. Describe the working of Iron - Carbon diagram with neat microstructure diagrams of each phase.

- V a) Explain the mechanism of plastic deformation with neat sketch.
- b) What are the functions of alloying elements and explain with neat sketch different strengthening mechanisms in alloys?

**OR**

- VI a) Explain the reason for the increase in ductility of most metals as the temperature is raised. And what influence does grain size have on the mechanical properties.
- b) Explain the difference in grain structure for a metal that has been cold worked and then recrystallized, with neat sketch.
- VII a) How does normalising differ from annealing as applied to steel? Explain it with neat sketch. What are the advantages of normalising process in respect of final properties?
- b) Discuss the influence of the following elements on the microstructure and properties of Cast Iron, with neat sketch 1. Silicon 2. Manganese 3. Sulphur 4. Phosphorus.

**OR**

- VIII a) What are the functions of alloying elements in tool steels? Identify 18:4:1 tool material, why is it so called even now.
- b) What is hardenability? Explain with neat sketch, the Jominy end quench test.

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- IX a) Explain the effect of plastic deformation in crack propagation and the Griffith theory with neat sketch.
- b) Distinguish between ductile & brittle fracture with graphs and neat sketches.

**OR**

- X a) What are the stress raisers? Describe the kind of fracture, which may occur as a result of a loose - fitting key on a shaft.
- b) Explain the type of fracture and the mode of the crack propagation in each case; if a metal subjected to  $x$  kgs load applied in step by step and the same load applied all of a sudden.

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