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***B.Tech. Degree IV Semester Examination in
Marine Engineering June 2014***

MRE 403 METALLURGY AND MATERIAL SCIENCE

Time : 3 Hours

Maximum Marks :100

(5 x 20 =100)

- I. (a) Distinguish between edge and screw dislocations. (5)
 (b) Draw a (111) plane and a (222) plane in the unit cell of a cubic lattice with lattice parameter a . Determine their distances from a parallel plane through the origin. (5)
 (c) Briefly explain the homogeneous and heterogeneous nucleation. (10)
- OR**
- II. (a) Explain the significance of Miller indices. (5)
 (b) Briefly explain the following: (10)
 (i) Atomic packing factor (ii) Inter planar spacing (iii) Polymorphism
 (c) Explain an application of the principles of nucleation and growth. (5)
- III. Explain iron-carbon equilibrium with a neat sketch and describe all the invariant reactions that occur, stating their names. (20)
- OR**
- IV. (a) What are the Hume-Rothery rules? (5)
 (b) Explain various types of solid solutions. (5)
 (c) Draw the steel region of the Fe-Fe₃C phase diagram and make neat sketches of microstructure expected for 0.8% carbon on cooling from austenitic region. (10)
- V. (a) Discuss any two case hardening techniques. (5)
 (b) What are the functions of alloying elements in steel? (5)
 (c) What are the compositions and uses of Cu and Al alloys? (5)
 (d) Distinguish between grey and malleable cast iron. (5)
- OR**
- VI. (a) Draw T-T-T diagram and explain its uses. (10)
 (b) State and explain the composition, properties and uses of two commercial alloys of Cu. (5)
 (c) Briefly describe the hardenability of steel and explain a test to quantify it. (5)
- VII. (a) Explain Griffith's theory of brittle fracture. (10)
 (b) Justify why zinc is less ductile than copper. (5)
 (c) Discuss the methods of protection against fracture. (5)
- OR**
- VIII. (a) Distinguish between hot and cold working. (10)
 (b) Briefly describe the mechanism of fatigue. (5)
 (c) Explain with reasons why brass is always stronger than copper at room temperature. (5)
- IX. (a) What are the materials used for propellers and rudders? Discuss their properties. (10)
 (b) Explain any three non-destructive tests. (10)
- OR**
- X. (a) Discuss the important characteristics of materials used in shipboard applications. (10)
 (b) Explain how proper materials are selected for boilers, steam and gas turbines. (10)