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***B.Tech. Degree IV Semester Supplementary Examination in
Marine Engineering June 2022***

**MRE 1403 METALLURGY AND MATERIAL SCIENCE
(2013 Scheme)**

Time: 3 Hours

Maximum Marks: 100

(5 × 20 = 100)

- I. (a) Explain the following: (i) Unit cell (ii) co-ordination number (iii) inter planar spacing (iv) twin boundary. (10)
(b) What is the significance of Burgers vector and Frank Read source in dislocation? (10)
- OR**
- II. (a) What is meant by Miller Indices? Sketch the following planes and directions in a cubic crystal (2 1 0), (0 2 0), [1 1 0], [1 0 2]. (10)
(b) Distinguish between homogenous and heterogeneous nucleation. (10)
- III. (a) What is solid solution? How are they classified? State Hume - Rothery rules for solid solution formation. (10)
(b) Discuss construction of isomorphous phase diagram and mark all points and regions. (10)
- OR**
- IV. (a) Draw the Iron-Iron carbide phase diagram, mark the different phase fields and explain the three invariant reactions involved. (12)
(b) State and explain Gibb's phase rule. (8)
- V. (a) With the aid of suitable cooling curves, explain the following processes: (12)
(i) Normalizing (ii) Hardening (iii) Austempering.
(b) Distinguish between carburizing and nitriding treatments. (8)
- OR**
- VI. (a) Which are the commonly used alloying elements in steel? What properties are imparted to steel by them? (10)
(b) Discuss the different types of bearing materials and their applications. (10)
- VII. (a) Distinguish between slip and twinning as modes of plastic deformation of metals and alloys. (10)
(b) Explain recovery, recrystallisation and grain growth stages during annealing. (10)
- OR**
- VIII. (a) What is creep in metals? Draw a typical creep curve and explain the three stages of creep. (10)
(b) Discuss the importance of consideration of fatigue in engineering design. Explain the mechanism of fatigue failure and methods of improving fatigue strength. (10)
- IX. (a) What does impact test signify? Explain with necessary formulations, the procedure to be adopted in the impact test conducted on a pendulum type impact testing machine. (10)
(b) What is non-destructive testing? Explain any two non-destructive tests. (10)
- OR**
- X. (a) Write characteristics of any two materials used for shipboard applications. (10)
(b) Discuss the composition, strength and other requirements for materials used in the following cases: (10)
(i) Boilers (ii) Pumping machinery (iii) Propellers