Roll No…….. **Total No. of Printed Pages:[1]**

Total No. of Questions: [09]

B. Tech. (Electrical Engg) (Semester –6th)

MATERIAL SCIENCE & ENGINEERING

Subject Code: BMEE0F94

Paper ID: [OE3111520]

Time: 03 Hours **Maximum Marks: 60**

Instruction for candidates:

1. Section A is compulsory. It consists of 10 parts of two marks each.
2. Section B consist of 5 questions of 5 marks each. The student has to attempt any 4 questions out of it.
3. Section C consist of 3 questions of 10 marks each. The student has to attempt any 2 questions.

Section – A **(2 marks each)**

Q1. Attempt the following:

a. Describe the crystal structure of a Face-Centered Cubic (FCC) lattice.
b. What is meant by crystallographic notation of atomic planes?
c. What is twinning in crystalline structure?
d. What are the key mechanical properties of engineering materials?
e. What is the principle of phase transformation in alloys?
f. How do time-temperature transformation (TTT) curves relate to the phase transformations in steel?
g. What is the purpose of annealing in heat treatment processes?
h. Name two surface-hardening processes and explain their purpose.
i. What is the primary difference between hardening and tempering processes?
j. How does the solubility of components in the solid state affect the overall structure and properties of an alloy?

Section – B **(5 marks each)**

Q2. What is the difference between Body-Centered Cubic (BCC) and Face-Centered Cubic (FCC) crystal structures in terms of atomic arrangement and slip systems?

Q3. Given a BCC crystal with an atomic radius of 0.155 nm, calculate the theoretical density of the metal. Assume the atomic mass is 55.8 g/mol and use the following:
Atomic mass = 55.8 g/mol
Atomic radius = 0.155 nm

Q4. Describe the equilibrium diagram of a binary system where the components form a mechanical mixture of crystals in the solid state that are completely soluble in the liquid state.

Q5. Discuss the equilibrium diagram of a binary alloy system where the components are completely soluble in the liquid phase and form a mechanical mixture of crystals in the solid phase. How does temperature affect the solidification and phase formation?

Q6. What are the common defects that can occur during heat treatment, and how can they be remedied?

Section – C **(10 marks each)**

Q7. Describe the process of solidification and crystallization in metals. Explain the phenomena of slip and twinning in metals, and their relationship to plastic deformation. How do dislocations play a role in these phenomena, and what are the different types of dislocations found in metal crystals?

Q8. Discuss the Iron-Carbon equilibrium diagram, including the phases present at different compositions and temperatures. Explain the formation of Austenite and the transformation from Austenite to Pearlite, as well as the Martensite transformation in steel.

Q9. Explain surface hardening processes, specifically carburizing and nitriding, and their applications. Explain the effects of alloying elements such as Si, Mn, Ni, Cr, Mo, Ti, and Al on the structure and properties of steel.