

## CBCS Scheme

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15ME32

**Third Semester B.E. Degree Examination, June/July 2017**  
**Material Science**

Time: 3 hrs.

Max. Marks: 80

**Note: Answer FIVE full questions, choosing one full question from each module.**

**Module-1**

- 1 a. With the help of Stress – strain diagrams, briefly explain the ductile and brittle behaviour of Engineering Materials. (08 Marks)
- b. A 0.2% C steel component is to be carburized at 920°C. Calculate the time required to increase the carbon content at 0.5mm below the surface to 0.4%.  
 $D_{920^{\circ}\text{C}} = 1.28 \times 10^{-11} \text{ m}^2/\text{S}$ . Carbon content is 0.9% at the surface. (08 Marks)

Z	0.75	0.80	0.85
erf Z	0.7112	0.7421	0.7707

**OR**

- 2 a. With a neat creep curve, explain different stages of creep deformation. (08 Marks)
- b. Explain the mechanisms of fatigue failure in engineering materials with necessary diagram. (08 Marks)

**Module-2**

- 3 a. What is meant by Homogeneous nucleation? Derive an expression for critical radius required for homogeneous nucleation, with free energy curve. (08 Marks)
- b. Explain Substitutional and Interstitial solid solutions. Discuss Hume – Rothary rules governing formation of solid solutions. (08 Marks)

**OR**

- 4 a. Draw a neat Iron – Carbon equilibrium phase diagram and label all phases, regions and invariant phase. (08 Marks)
- b. Two metals A & B are completely soluble in liquid and partially soluble in solid state. Draw their phase diagram for following details.  
 i) Solid solubility of B in A is 5% at 600°C and 0°C.  
 ii) Solid solubility of A in B is 10% at 600°C and 0°C.  
 iii) Eutectic is formed at 60% B.  
 Also find the liquid and solid phase percentages in an alloy with 20% B at 650°C. (08 Marks)

**Module-3**

- 5 a. Draw a neat labeled TTT diagram for eutectoid steel. Show a cooling curve for the formation of 100% martensite on it and explain the curve. (08 Marks)
- b. Differentiate clearly between Normalizing and Annealing. Discuss Spheroidising Annealing with applications. (08 Marks)

**OR**

- 6 a. With a neat diagram, explain induction hardening process. Discuss the advantages, limitations and applications of the process. (08 Marks)
- b. Discuss on various types of cast irons with necessary micro structures. (08 Marks)

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.  
 2. Any revealing of identification, appeal to evaluator and/or equations written eg. 42+8 = 50, will be treated as malpractice.

**Module-4**

- 7 a. Differentiate between Thermo setting and Thermoplastic polymers. What are the advantages and disadvantages of plastic materials? (08 Marks)  
b. What is meant by Residual Life Assessment? Explain the Nondestructive testing methods useful for Assessing residual life of materials. (08 Marks)

**OR**

- 8 a. Describe Shape memory alloys. Explain briefly the applications of shape memory alloys. (08 Marks)  
b. Classify Ceramic materials. Explain the application and processing method of any one class. (08 Marks)

**Module-5**

- 9 a. Classify the composite materials on matrix and reinforcement. List the roles of matrix, reinforcement and interface. (08 Marks)  
b. For a directionally oriented fiber – reinforced composite, the Young's modulus in iso - strain and iso – stress condition are 33.1 GPa and 3.66 GPa respectively. For a fiber volume fraction of 0.30, determine the Yong's modules for fiber and matrix phases. (08 Marks)

**OR**

- 10 a. With a neat figure, explain Injection moulding process for particulate reinforced polymers. (08 Marks)  
b. List the advantages and limitations of composite materials. Mention any four applications of polymer matrix composites. (08 Marks)

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