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Subject Code:- BOE0362

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA

(An Autonomous Institute Affiliated to AKTU, Lucknow)

B.Tech

SEM: III - THEORY EXAMINATION (2024 - 2025)

Subject: Material Science

Time: 3 Hours Max. Marks: 100

General Instructions:

IMP: *Verify that you have received the question paper with the correct course, code, branch etc.*

1. This Question paper comprises of three Sections -A, B, & C. It consists of Multiple Choice Questions (MCQ's) & Subjective type questions.

2. Maximum marks for each question are indicated on right -hand side of each question.

3. Illustrate your answers with neat sketches wherever necessary.

4. Assume suitable data if necessary.

5. Preferably, write the answers in sequential order.

6. No sheet should be left blank. Any written material after a blank sheet will not be evaluated/checked.

SECTION-A 20

1. Attempt all parts:-

1-a. Which of the following mechanical properties is a measure of a material's resistance to plastic deformation? [CO1, K1] 1

(a) Modulus of Elasticity

(b) Yield Strength

(c) Toughness

(d) Ductility

1-b. What is the process of plastically deforming a metal at a temperature below its recrystallization temperature? [CO1, K1] 1

(a) Cold working

(b) Hot working

(c) Annealing

(d) Quenching

1-c. Which heat treatment process involves rapid cooling to obtain a martensitic microstructure?[CO2, K1] 1

(a) Annealing

(b) Normalizing

(c) Quenching

(d) Tempering

1-d. Fick's first law describes:[CO2, K1] 1

(a) Steady-state diffusion
(b) Non-steady-state diffusion
(c) Diffusion in liquids
(d) Diffusion in gases

1-e. Piezoelectric materials convert:[CO3, K1] 1

(a) Mechanical energy into electrical energy
(b) Electrical energy into mechanical energy
(c) Both a and b
(d) None of the above

1-f. Shape memory alloys exhibit: [CO3, K1] 1

(a) Superconductivity
(b) Shape memory effect
(c) Ferromagnetism
(d) Piezoelectricity

1-g. Fiber-reinforced composites are classified based on: [CO4, K1] 1

(a) Fiber orientation
(b) Matrix material
(c) Fiber type
(d) All of the above

1-h. Which of the following is a disadvantage of using composite materials? [CO4, K1] 1

(a) High cost
(b) Complex manufacturing processes
(c) Potential for damage during fabrication
(d) All of the above

1-i. Transmission electron microscopy (TEM) provides information about: [CO5, K1] 1

(a) Surface morphology
(b) Internal microstructure
(c) Magnetic properties
(d) Thermal conductivity

1-j. Differential scanning calorimetry (DSC) is used to: [CO5, K1] 1

(a) Measure the thermal properties of a material
(b) Determine the mechanical properties of a material
(c) Analyze the chemical composition of a material
(d) Image the surface of a material

2. Attempt all parts:-

2.a. Write down the difference between elastic and plastic deformation? [CO1, K2] 2

2.b. What are the common case hardening processes?[CO2, K1] 2

2.c.	Discuss the role of magnetostrictive materials in actuator applications. [CO3, K2]	2
2.d.	What are the advantages and disadvantages of using polymer matrix composites?[CO4, K1]	2
2.e.	What is the principle of eddy current testing?[CO5, K1]	2

SECTION-B 30

3. Answer any five of the following:-

3-a.	Why mechanical testing perform. Describe the impact testing and tensile testing techniques used to evaluate the mechanical properties of materials.[CO1, K2]	6
3-b.	Differentiate between cold working and hot working of metals. Also write down the applications of cold working process.[CO1, K2]	6
3-c.	What is case hardening. write down the advantages and limitations of case hardening.[CO2, K2]	6
3-d.	Explain the role of diffusion in thermal oxidation. [CO2, K2]	6
3.e.	Discuss the various types of smart materials and their applications in engineering. [CO3, K2]	6
3.f.	Distinguish between composite and alloys. also discuss how composite materials are classified.[CO4, K2]	6
3.g.	Explain the Bragg's law and its application in X-ray diffraction.[CO5, K2]	6

SECTION-C 50

4. Answer any one of the following:-

4-a.	The results of a tensile test are: Diameter of specimen 20 mm, gauge length 50 mm, load at limit of proportionality 80 kN, extension at limit of proportionality 0.075 mm, maximum load 100 kN, and final length at point of fracture 60 mm. Determine (a) Young's modulus of elasticity, (b) the ultimate tensile strength, (c) the stress at the limit of proportionality, (d) the percentage elongation. [CO1, K3]	10
4-b.	Explain the mechanisms of plastic deformation in metals.[CO1, K2]	10

5. Answer any one of the following:-

5-a.	Explain the impact of heat treatment on the mechanical properties of steel.[CO2, K2]	10
5-b.	Derive Fick's laws of diffusion. [CO2, K3]	10

6. Answer any one of the following:-

6-a.	Analyze the impact of advanced materials on the aerospace and automotive industries. [CO3, K2]	10
6-b.	Explain the concept of multifunctional materials and their potential applications. [CO3, K2]	10

7. Answer any one of the following:-

7-a.	Explain the principle and applications of two processes used in manufacturing of	10

metal matrix composites. [CO4, K2]

7-b. What do you understand by reinforcement materials. Explain fibre reinforced composite materials with their industrial applications. [CO4, K2] 10

8. Answer any <u>one</u> of the following:-

8-a. Explain the working principle of a scanning electron microscope.[CO5, K2] 10

8-b. Explain the working principle of a differential scanning calorimeter.[CO5, K2] 10