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Printed Page:-4 **Subject Code:- BME0305**

Roll. No:

NOIDA INSTITUTE OF ENGINEERING AND TECHNOLOGY, GREATER NOIDA
(An Autonomous Institute Affiliated to AKTU, Lucknow)
B.Tech
SEM: III - THEORY EXAMINATION (2025 - 2026)
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. Plastic deformation occurs mainly due to? (CO1, K1) 1

(a) Elastic strain
(b) Dislocation movement
(c) Grain growth
(d) Creep

1-b. Recrystallization temperature decreases with? (CO1, K1) 1

(a) Increased grain size
(b) Cold work
(c) Hot work
(d) None

1-c. Quenching is done to achieve? (CO2, K1) 1

(a) Softness
(b) High hardness
(c) High ductility
(d) Grain growth

1-d. Bainite forms at temperatures? (CO2, K1) 1

(a) High temperature
(b) Intermediate temperature
(c) Room temperature
(d) Below melting point

1-e. Thermo-responsive materials change properties with? (CO3, K1) 1

(a) Pressure
(b) Temperature
(c) Magnetic field
(d) Voltage

1-f. Semi-conductive materials have? (CO3, K1) 1

(a) High conductivity
(b) Intermediate conductivity
(c) No conductivity
(d) Magnetic properties

1-g. Ceramic matrix composites (CMC) are mainly used for? (CO4, K1) 1

(a) Aerospace and turbine blades
(b) Jewelry
(c) Food packaging
(d) Electronics

1-h. Fiber orientation affects? (CO4, K1) 1

(a) Mechanical properties of composite
(b) Density only
(c) Thermal conductivity only
(d) Corrosion resistance

1-i. Differential Scanning Calorimetry (DSC) is used to measure? (CO5, K1) 1

(a) Stress
(b) Heat flow with temperature
(c) Diffusion
(d) Density

1-j. Grain size in a metal can be observed by? (CO5, K1) 1

(a) SEM
(b) Metallographic microscope
(c) DSC
(d) AFM

2. Attempt all parts:-

2.a. State the difference between tensile strength and yield strength. (CO1, K2) 2

2.b. Explain the importance of TTT diagram in heat treatment. (CO2, K2) 2

2.c. What are shape memory alloys? Give one example. (CO3, K1) 2

2.d. Explain the difference between metal matrix and polymer matrix composites. (CO4, K2) 2

2.e. Define Differential Scanning Calorimetry (DSC). (CO5, K1) 2

SECTION-B 30

3. Attempt all parts:-

3.a. Answer any one of the following:-

3.a.(i) Analyze creep behavior in metals at high temperatures and suggest preventive 6

measures. (CO1, K4)

3.a.(ii)	Compare the microstructure and properties of ferrous and nonferrous alloys with examples. (CO1, K3)	6

3.b. Answer any one of the following:-

3.b.(i)	A steel specimen is quenched rapidly from 900°C. Analyze the expected microstructural changes and their effect on hardness. (CO2, K3)	6
3.b.(ii)	Apply diffusion principles to explain the process of doping in semiconductors with suitable examples. (CO2, K3)	6

3.c. Answer any one of the following:-

3.c.(i)	Apply the concept of chromic materials in smart windows and analyze their advantages. (CO3, K3)	6
3.c.(ii)	Compare the properties of biomaterials with conventional materials and apply their uses in implants. (CO3, K4)	6

3.d. Answer any one of the following:-

3.d.(i)	Evaluate the advantages and disadvantages of thermoplastic and thermosetting matrix composites in industrial applications. (CO4, K4)	6
3.d.(ii)	Apply knowledge of reinforcement types to design a composite for high wear resistance. (CO4, K3)	6

3.e. Answer any one of the following:-

3.e.(i)	Apply the principle of Atomic Absorption Spectroscopy (AAS) to determine the concentration of metal ions in a water sample. Illustrate with a calculation example. (CO5, K3)	6
3.e.(ii)	Compare and analyze Ultrasonic Testing (UT) and Radiographic Testing (RT) for detecting internal defects in castings. (CO5, K3)	6

SECTION-C 50

4. Answer any one of the following:-

4-a.	Analyze the complete stress–strain response of metals, ceramics, and polymers. Discuss differences in yield strength, toughness, and ductility. (CO1, K4)	10
4-b.	Analyze the iron–carbon phase diagram and explain microstructural transformations occurring when eutectoid steel is cooled slowly from 900°C. (CO1, K4)	10

5. Answer any one of the following:-

5-a.	Apply the concept of normalizing to suggest its industrial applications for improving machinability and toughness. (CO2, K3)	10
5-b.	Analyze the factors affecting diffusion during sintering of metal powders and their effect on density. (CO2, K4)	10

6. Answer any one of the following:-

6-a.	Compare rheological materials with conventional fluids and analyze their role in adaptive automotive suspension systems. (CO3, K3)	10
6-b.	Analyze the applications of superalloys in aerospace engines and compare them with conventional alloys. (CO3, K4)	10

7. Answer any one of the following:-

7-a.	Analyze and classify the types of matrix and reinforcement suitable for marine	10

applications, considering environmental and mechanical requirements. (CO4, K4)

7-b.	Using laminate theory, estimate the stiffness of a [0°/90°]s glass-epoxy laminate given fiber and matrix properties (provide necessary assumptions). (CO4, K3)	10

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

8-a.	Analyze the differences in imaging and resolution between SEM and TEM, and suggest suitable applications for each technique. (CO5, K4)	10
8-b.	Using DSC data, a metal sample shows an endothermic peak at 660 °C corresponding to melting. Analyze how this data can be used to determine purity of the metal. (CO5, K4)	10