

GUJARAT TECHNOLOGICAL UNIVERSITY

BE-3 SEMESTER – OLD PAPER – S22 TO S25 – QUESTION BANK

Subject Name & Code:

Material Science and Metallurgy (3131904)

Unit 1 – Introduction to Material Science and Metallurgy

Repeated Questions:

1. **Classify engineering materials.**
 - Appeared in: W22 (Q1b, 04 marks), S25 (Q1b, 04 marks), S24 (Q1a, 03 marks)
2. **Explain/Define material properties: Ductility, Creep, Hardness, Strength, Elasticity.**
 - Appeared in: W22 (Q1a, 03 marks), W23 (Q1a, 03 marks), S25 (Q1a, 03 marks), W24 (Q1a, 03 marks)
3. **Explain criteria for selection of materials for engineering applications.**
 - Appeared in: W23 (Q1c, 07 marks), S24 (Q1c, 07 marks)

Other Important Questions:

1. **What are engineering materials and how are they classified?**
 - W24 (Q1a, 03 marks)
2. **Explain the role of material science and metallurgy in advancement of civilization.**
 - S24 (Q1b, 04 marks)
3. **What is Metallurgy? List its functions.**
 - S23 (Q1a, 03 marks)
4. **List mechanical properties and explain any two.**
 - S23 (Q1b, 04 marks)

Unit 2 – Crystal Geometry and Crystal Imperfection

Repeated Questions:

1. **Explain Bravais lattice with neat diagrams.**
 - Appeared in: S23 (Q1c, 07 marks)
2. **Calculate atomic packing factor for SC, BCC, FCC structures.**
 - Appeared in: W24 (Q1b, 04 marks), S25 (Q1c, 07 marks), S24 (Q2b, 04 marks)
3. **Differentiate between edge dislocation and screw dislocation with neat sketches.**
 - Appeared in: W22 (Q1c, 07 marks), W23 (Q1c, 07 marks), W24 (Q2c OR, 07 marks), S24 (Q3b, 04 marks)

Other Important Questions:

1. **Explain grain boundary as a crystalline imperfection.**
 - S23 (Q2a, 03 marks)
2. **Determine Miller indices of a plane that makes intercepts of $2\text{\AA}$, $3\text{\AA}$, $4\text{\AA}$ on orthorhombic crystal axes ($a:b:c = 4:3:2$).**
 - S23 (Q2b, 04 marks)
3. **Explain arrangement of atoms in BCC, FCC, HCP lattices.**
 - S23 (Q2c, 07 marks)
4. **Explain Frenkel and Schottky defects.**
 - S24 (Q3b OR, 04 marks)
5. **Explain different methods for grain size measurement.**
 - S23 (Q2c OR, 07 marks)

Unit 3 – Solidification and Theory of Alloys

Repeated Questions:

1. **Explain mechanism of crystallization: nucleation and growth.**
 - Appeared in: W24 (Q2c, 07 marks), S24 (Q2c, 07 marks)
2. **Explain homogeneous vs. heterogeneous nucleation.**
 - Appeared in: S23 (Q4b OR, 04 marks), W24 (Q3b OR, 04 marks)
3. **Derive formula for critical radius for homogeneous nucleation.**
 - Appeared in: W23 (Q2c OR, 07 marks), S24 (Q2c, 07 marks)

Other Important Questions:

1. **Explain solidification process in metals.**
 - S25 (Q3a, 03 marks)
2. **Explain types of growth of nucleus for metals and alloys.**
 - S23 (Q4a OR, 03 marks)
3. **What are requirements for solidification to initiate and proceed?**
 - S23 (Q4c, 07 marks)
4. **Draw microstructure of solidified pure metal ingot.**
 - S24 (Q4a, 03 marks)
5. **Draw cooling curve for pure metal.**
 - S24 (Q4a OR, 03 marks)

Unit 4 – Phase and Phase Equilibrium

Repeated Questions:

1. **State and explain Hume-Rothery rules.**
 - Appeared in: W23 (Q2c, 07 marks), W24 (Q3a, 03 marks)
2. **Explain Gibbs phase rule and apply to unary/binary systems.**
 - Appeared in: W22 (Q2c OR, 07 marks), W24 (Q3c, 07 marks), S25 (Q2c OR, 07 marks), S24 (Q3c, 07 marks)
3. **Define solid solution and explain types.**
 - Appeared in: S25 (Q2a, 03 marks), S24 (Q4c OR, 07 marks)

Other Important Questions:

1. **Explain Lever rule with binary phase diagram.**
 - S25 (Q3b OR, 04 marks)
2. **Write invariant reactions: eutectic, peritectoid, monotectic, eutectoid.**
 - S24 (Q4b, 04 marks), S24 (Q4b OR, 04 marks)
3. **Explain non-equilibrium cooling.**
 - S25 (Q3b, 04 marks), S24 (Q3a OR, 03 marks)
4. **Explain allotropy with reference to iron.**
 - S25 (Q3c, 07 marks)

Unit 5 – Non-ferrous Metal and Alloys (Unit of New Syllabus)

Repeated Questions:

Other Important Questions:

Unit 6 – TTT Diagrams and Heat Treatment of Steel

Repeated Questions:

1. **Draw TTT diagram for eutectoid steel with necessary notations.**
 - Appeared in: W24 (Q4c, 07 marks)
2. **Justify need of heat treatment for metals and explain TTT diagram.**
 - Appeared in: W22 (Q4c, 07 marks), S25 (Q4c, 07 marks)
3. **Differentiate annealing and normalizing.**
 - Appeared in: W22 (Q4b, 04 marks), S23 (Q4b, 04 marks), W23 (Q4b, 04 marks)

Other Important Questions:

1. **Define heat treatment and classify processes.**
 - W23 (Q4a, 03 marks)
2. **Explain full annealing process.**
 - S25 (Q4a, 03 marks), S24 (Q5c, 07 marks)
3. **Explain flame hardening.**
 - W22 (Q5b, 04 marks), S25 (Q4b, 04 marks)
4. **Explain pack carburizing.**
 - W22 (Q4b OR, 04 marks)
5. **List various heat treatment processes for steels.**
 - S23 (Q5a OR, 03 marks)

Unit 7 – Powder Metallurgy

Repeated Questions:

1. **Define powder metallurgy and state advantages, limitations, applications.**
 - Appeared in: W22 (Q5c, 07 marks), S25 (Q4c OR, 07 marks), W24 (Q5a, 03 marks)
2. **Explain production methods of metal powders.**
 - Appeared in: W24 (Q5b OR, 04 marks), S24 (Q5a, 03 marks)
3. **Explain characteristics of metal powders.**
 - Appeared in: W23 (Q4c OR, 07 marks), W24 (Q4b OR, 04 marks)

Other Important Questions:

1. **Explain sintering process.**
 - W22 (Q5a OR, 03 marks)
2. **List applications of powder metallurgy.**
 - S24 (Q5a OR, 03 marks)
3. **Explain any one method for production of metal powders.**
 - S25 (Q4a OR, 03 marks)

Unit 8 – Non-Destructive Testing

Repeated Questions:

1. **Explain dye penetrant testing with principle, procedure, advantages, limitations.**
 - Appeared in: W22 (Q5a, 03 marks), S25 (Q4b OR, 04 marks), S24 (Q5c OR, 07 marks), W24 (Q5c OR, 07 marks)
2. **Explain radiography testing method with advantages and limitations.**
 - Appeared in: W22 (Q4c OR, 07 marks), S23 (Q5c, 07 marks), S25 (Q5c, 07 marks)
3. **Compare destructive and non-destructive testing.**
 - Appeared in: S25 (Q5b, 04 marks)

Other Important Questions:

1. **State various NDT methods and advantages of RT over UT.**
 - W24 (Q5b, 04 marks)
2. **Explain ultrasonic testing method with advantages and limitations.**
 - S25 (Q5c OR, 07 marks)
3. **Explain LPT and MPT differences.**
 - W23 (Q5b, 04 marks)
4. **Explain principle of radiography testing and use in metal testing.**
 - W23 (Q4c OR, 07 marks)
5. **Explain NDT methods for inspection of castings.**
 - W23 (Q5c, 07 marks)

Unit 9 – Corrosion of Metals and Alloys

Repeated Questions:

1. **Explain mechanism of corrosion and prevention techniques.**
 - Appeared in: W22 (Q5c OR, 07 marks), W24 (Q5c, 07 marks)
2. **Explain cathodic protection against corrosion.**
 - Appeared in: S25 (Q5a, 03 marks), S23 (Q5b, 04 marks)
3. **Classify types of corrosion.**
 - Appeared in: S25 (Q5b OR, 04 marks), S24 (Q5b OR, 04 marks)

Other Important Questions:

1. **Define corrosion and classify.**
 - W24 (Q5a OR, 03 marks)
2. **Differentiate dry and wet corrosion.**
 - W23 (Q5b, 04 marks)
3. **Explain various corrosion prevention methods.**
 - W24 (Q5c, 07 marks)

Unit 10 – Metallography (Unit of New Syllabus)

Repeated Questions:

Other Important Questions:
