

Course Code: MET205

Course Name: METALLURGY AND MATERIAL SCIENCE

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all questions. Each question carries 3 marks

Marks

- | | | |
|----|---|-----|
| 1 | Compare covalent bonds with Ionic bonds. | (3) |
| 2 | Define atomic packing factor. Calculate the APF for a BCC structure. | (3) |
| 3 | Compare scanning electronic microscope (SEM) with Transmission electron microscope (TEM). | (3) |
| 4 | What is diffusion in Solids? State and explain the Fick's law of diffusion. | (3) |
| 5 | Compare CCT diagram with TTT diagram for an eutectoid iron carbon alloy. | (3) |
| 6 | With a neat sketch describe the Jominy end quench test. | (3) |
| 7 | How does the carbon content effect the properties of carbon steel? | (3) |
| 8 | Which are the important properties associated with high speed steel? | (3) |
| 9 | What is the composition of Maraging steels? Where do Maraging steel find application? | (3) |
| 10 | Which are the common types of ceramics? | (3) |

PART B

Answer any one full question from each module. Each question carries 14 marks

Module 1

- | | | |
|----|---|------|
| 11 | What is plastic deformation? Describe the slip and twinning modes of plastic deformation with simple sketches. | (14) |
| 12 | What are the miller indices? Explain the procedure for obtaining miller indices for any crystallographic plane with a suitable example. | (14) |

Module 2

- | | | |
|----|---|------|
| 13 | (a) Define dislocations. (4 marks) | (14) |
| | (b) With the help of simple sketches differentiate between edge dislocation and screw dislocation. (10 Marks) | |

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- 14 (a) Describe the steps involved in preparing a sample for metallographic examination. (5 marks) (14)
- (b) Why is metallographic etching done? Describe the main metallographic etching process. (9 marks)

Module 3

- 15 (a) What is the difference between hardness, hardening process and hardenability? (6 marks) (14)
- (b) What is surface hardening? Compare induction hardening process with surface diffusion hardening process. (8 marks)
- 16 With the help of an iron carbon diagram explain the eutectoid, eutectic and peritectic reaction of iron carbon alloy system. (14)

Module 4

- 17 (a) What is the strengthening of metals? Why is strengthening carried out? (4 marks) (14)
- (b) Compare solid solution hardening with age hardening. (10 marks)
- 18 (a) Differentiate between hot and cold working? (4 marks) (14)
- (b) Compare phase transformation hardening with strain hardening. (10 marks)

Module 5

- 19 (a) Discuss the composition, properties and applications of Metal Matrix Composites and Ceramic Matrix Composites. (8 marks) (14)
- (b) Define superplasticity. Why superplasticity is needed and what are its areas of applications? (6 marks)
- 20 (a) Define creep and sketch the creep curve. (7 marks) (14)
- (b) Describe the mechanism of creep. (7 marks)

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY
Third Semester B.Tech Degree Examination December 2021 (2019 scheme)

Course Code: MET205

Course Name: METALLURGY & MATERIAL SCIENCE

Max. Marks: 100

Duration: 3 Hours

PART A

Answer all questions. Each question carries 3 marks

Marks

- | | | |
|----|--|---|
| 1 | Explain the good electrical and thermal conductivity of metals with respect to their atomic bonding? | 3 |
| 2 | How polymorphism differ from allotropy? | 3 |
| 3 | How high angle grain boundary differ from low angle grain boundary? | 3 |
| 4 | What is forest of dislocation? | 3 |
| 5 | Define Gibbs phase rule. | 3 |
| 6 | What are the stages involved in normalizing heat treatment process? | 3 |
| 7 | What is HSLA steel? | 3 |
| 8 | What is malleable iron? | 3 |
| 9 | What is deformation by creep? | 3 |
| 10 | How composite differ from metals, polymers and ceramics? | 3 |

PART B

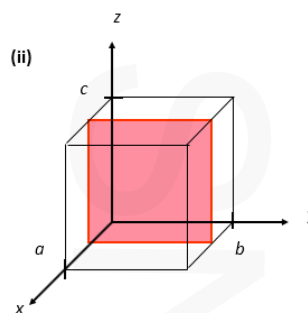
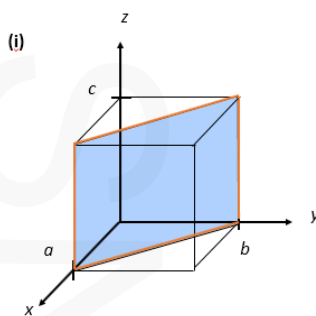
Answer any one full question from each module. Each question carries 14 marks

Module 1

- 11 a.) Define co-ordination number and atomic packing factor. **(3mark)**
 b) Estimate effective number of atoms, co-ordination number and atomic packing factor for an HCP. **(11 marks)** 14

OR

- 12 a) Explain the procedure to find Miller indices for a plane. **(4 marks)**
 b) Find the miller indices for the following planes? **(8 marks)** 14



- c) What are equivalent planes? **(2 marks)**

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Module 2

- 13 Describe the following defects in crystalline materials (14)
- a) Point defects (4 marks)
 - b) Dislocations or linear defects (6 marks)
 - c) Surface defects (4 marks)

OR

- 14 a) Derive expression for Fick's laws of diffusion. (10 marks) (14)
- b) What are the applications of diffusion? (4 marks)

Module 3

- 15 a) With a neat sketch explain binary isomorphous phase diagram. (6 marks) (14)
- b) How composition and relative phase fraction can be determined in the two-phase region in a binary isomorphous phase diagram? (8 marks)

OR

- 16 Describe the following (14)
- a) Austempering (5marks)
 - b) Martempering (5 marks)
 - c) Ausforming (4 marks)

Module 4

- 17 a. Explain the phenomena of recovery, recrystallisation and grain growth intimately associated with the annealing of a plastically deformed crystalline material. (9 marks) (14)
- b. How Bauschinger effect help in metal forming of materials? (5 marks)

OR

- 18 a) How alloying effects the *Polymorphic transformation temperature and critical cooling rate of the steels?* (8 marks) (14)
- b) Name any 6 alloying elements, their concentration and function when added to steels. (6 marks)

Module 5

- 19 a) Describe the mechanism and structural features of fatigue failure. (8marks) (14)
- b) Discuss the property super-plasticity. What are its engineering applications? (6 marks)

OR

- 20 a) Explain Griffith theory of brittle fracture. (10 marks) (14)
- b) List out various methods of protection against fracture. (4 marks)

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APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY

Third Semester B.Tech Degree Regular and Supplementary Examination December 2022 (2019 Scheme)

Course Code: MET205**Course Name: METALLURGY AND MATERIAL SCIENCE**

Max. Marks: 100

Duration: 3 Hours

PART A*Answer all questions. Each question carries 3 marks*

Marks

- | | | |
|----|---|-----|
| 1 | Describe the importance of long range and short range order of atomic arrangement on mechanical strength in solids. | (3) |
| 2 | Write three differences between slip & twinning. | (3) |
| 3 | What is Frank-Read source? | (3) |
| 4 | What are the distinct features of Scanning Electronic Microscope (SEM)? | (3) |
| 5 | What do you mean by critical cooling rate in CCT diagram? | (3) |
| 6 | How phase amounts can be determined using phase diagram? | (3) |
| 7 | Describe precipitation hardening mechanism in materials. | (3) |
| 8 | List the composition, properties, and use of Gun metal. | (3) |
| 9 | What are composites? Give one example and its application. | (3) |
| 10 | Differentiate Creep & Fatigue. | (3) |

PART B*Answer any one full question from each module. Each question carries 14 marks***Module 1**

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|----|---|-----|
| 11 | a) Prove that the resolved shear stress on the slip plane in the slip direction is zero, when the slip plane is normal to the stress axis | (7) |
| | b) Explain atomic packing factor and its importance. | (4) |
| | c) Compare primary bond with secondary bond. | (3) |
| 12 | a) Explain the phenomenon recovery, recrystallization and grain growth. | (9) |
| | b) State and explain Schmid's law. | (5) |

Module 2

- | | | |
|----|---|-----|
| 13 | a) How X-Ray diffraction technique is utilized for the determination of crystal structures? | (4) |
|----|---|-----|

- b) A hardening process is performed at 1000°C on an iron–carbon alloy. The initial concentration of carbon in the alloy is 0.20 wt% C. The surface concentration is to be maintained at 1.30 wt% C. Determine the carburizing time needed to achieve a carbon concentration of 0.45 wt% at a position 2 mm. Assume the error function value 'z' as 0.85. The temperature-independent preexponential of diffusion is $2.3 \times 10^{-5} \text{ m}^2/\text{sec}$ and the activation energy is 148 kJ/mol. (10)
- 14 a) Write a short note on different types of Line defects occur in crystals. (7)
- b) Explain unsteady state diffusion. Derive the equation for Fick's second law. (7)

Module 3

- 15 a) Write the procedure for constructing TTT diagram. Mark all regions in a TTT diagram for Fe-C alloy system (10)
- b) Differentiate Normalising & Annealing. (4)
- 16 a) Why surface hardening processes are done on steels? Explain any two surface hardening methods. (10)
- b) What is invariant reaction? Compare eutectoid and peritectoid reaction. (4)

Module 4

- 17 a) How various alloying elements influence the property of steel? (7)
- b) Give the composition and applications of i) high speed steel ii) white iron (4)
- c) How cold working increases the strength of a material? (3)
- 18 a) Explain the following strengthening mechanism in metals. (5)
- i) Strengthening by grain size reduction (5)
- ii) Solid solution strengthening (5)
- b) What are non-ferrous alloys? Give two examples and their applications. (4)

Module 5

- 19 a) With the aid of S-N curve explain the mechanism of Creep. (10)
- b) What are super alloys? List its advantages and applications (4)
- 20 a) What is fatigue failure? Explain various factors that affect the fatigue life of a material. (10)
- b) What is maraging steel? Write any two engineering applications (4)