

Reg No.: \_\_\_\_\_

Name: \_\_\_\_\_

**APJ ABDUL KALAM TECHNOLOGICAL UNIVERSITY**

Third Semester B.Tech Degree (S, FE) Examination June 2024 (2019 Scheme)

**Course Code: RAT201****Course Name: PROCESSING AND PROPERTIES OF MATERIALS**

Max. Marks: 100

Duration: 3 Hours

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

Marks

- |    |   |     |
|----|---|-----|
| 1  | Define a chemical bond. Explain any two types bonds with examples.  | (3) |
| 2  | 'Even though BCC and FCC have same number of slip systems, FCC is more ductile than BCC.' Justify this statement. | (3) |
| 3  | Differentiate between Frenkel and Schottky defect with neat drawings  | (3) |
| 4  | Write any 3 applications of diffusion   | (3) |
| 5  | Differentiate between phases and components with examples.  | (3) |
| 6  | Describe carburizing process  | (3) |
| 7  | Explain about Nickel and its alloys   | (3) |
| 8  | What are composite biomaterials? Explain any few with their applications.   | (3) |
| 9  | Differentiate between diamagnetism and paramagnetism  | (3) |
| 10 | Describe the properties of Invar  | (3) |

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

- |    |  |           |
|----|--|-----------|
| 11 | (a) Briefly explain the following:   | (14)      |
|    | - Effective number of atoms per unit cell  |           |
|    | - Radius ratio   | (4 Marks) |
|    | (b) Determine the atomic packing factor for a BCC crystal structure  | (5 Marks) |
|    | (c) Copper has FCC crystal structure. Determine its density, if atomic weight is 63.54 grams/mole and atomic radius (r) is 1.287Å. | (5 Marks) |

- 12 (a) Discuss Polymorphism and Allotropy with few examples. (4 Marks) (14)  
 (b) Explain the procedure to find Miller Indices for a plane. Draw the planes and directions of the following Miller indices in a cubic unit cell (5 Marks)

$(1\ 1\ 2)$ ;  $(0\ \bar{1}\ 2)$ ;  $[1\ 2\ \bar{2}]$ ;  $[3\ 0\ 1]$

- (c) Explain the Mechanism of crystallization with neat drawings. (5 Marks)

### Module 2

- 13 (a) Briefly describe the various stages involved in the surface preparation of the specimen for microstructure evaluation. (7 Marks) (14)  
 (b) Explain diffusion mechanisms. Describe Fick's second law of diffusion. (7 Marks)
- 14 (a) What are crystalline defects? Explain Line and Surface defects with neat drawings. Also, give few examples. (8 Marks) (14)  
 (b) Describe a grain boundary. How does high and low angle grain boundaries influence the strength of a material? (6 Marks)

### Module 3

- 15 (a) What useful information does a phase diagram provides? Describe the following in a phase diagram: (14)  
 • Tie-lines  
 • Eutectic point (4 Marks)
- (b) With a neat sketch, explain the various phases involved in the Fe-Fe<sub>3</sub>C equilibrium diagram and also give the equations for the invariant reactions depicted in it. (10 Marks)
- 16 (a) Justify the need of heat treatment processes for the metals. What are the various stages involved? (4 Marks) (14)  
 (b) Explain the following heat treatment operations.
- Hardening
  - Normalizing
  - Full Annealing
  - Martempering

Include the microstructure variations, critical temperatures, and cooling methods. Also mention the phases formed at the end of these processes.

(10 Marks)



**Module 4**

- 17 (a) Make a brief note on Copper alloys and their industrial applications. (14)  
(5 Marks)
- (b) What are metal matrix composites (MMC)? Mention the characteristics of MMC with their specific application areas. (5 Marks)
- (c) Explain structural composites. How they are classified? (4 Marks)
- 18 (a) Describe about aluminium alloys and their applications (5 Marks) (14)
- (b) Explain the Carbon Fiber-Reinforced Polymer (CFRP) Composites. List out the major applications. (5 Marks)
- (c) Illustrate the mechanism of deformation in semi crystalline polymers (4 Marks)

**Module 5**

- 19 (a) In terms of electron energy band structure, explain the reasons for the difference in electrical conductivity between metals, semiconductors, and insulators (8) Marks (14)
- (b) Explain the formation of thermal stresses in a material. Use suitable diagrams and necessary equations. (6) Marks
- 20 (a) Illustrate the phenomenon of hysteresis (8 Marks) (14)
- (b) Distinguish between the materials based on their light transmitting capacity. Give examples and their applications. (6 Marks)