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**P.E.S. College of Engineering, Mandya - 571 401**  
 (An Autonomous Institution affiliated to VTU, Belgaum)  
**Fourth Semester, B.E. – Industrial and Production Engineering**  
**Semester End Examination; June - 2016**  
**Material Science and Metallurgy**

Time: 3 hrs

Max. Marks: 100

*Note: Answer FIVE full questions, selecting ONE full question from each unit.*

**UNIT - I**

- |      |   |    |
|------|---|----|
| 1 a. | Define a unit cell. Determine Atomic packing factor of face centered Cubic (FCC) structure.   | 10 |
| b.   | Zinc has HCP structure. The height of the unit cell is 0.494 mm. The nearest neighbor is at a distance of 0.27 mm. Calculate the volume of unit cell of Zinc. | 5  |
| c.   | Differentiate between edge dislocation and screw dislocation.   | 5  |
| 2 a. | With a neat sketch explain Tilt boundaries in crystals.   | 10 |
| b.   | State Ficks 1 <sup>st</sup> Law of Diffusion. Briefly explain atomic diffusion by vacancy migration and interchange of atoms.                                 | 10 |

**UNIT - II**

- |      |  |    |
|------|--|----|
| 3 a. | Define true stress and true strain. Derive the relationship between true strain and conventional strain. | 8  |
| b.   | Explain the following :<br>i) Plastic deformation by slip<br>ii) Stages of cup and cone fracture.        | 12 |
| 4 a. | Explain factors affecting fatigue life.  | 8  |
| b.   | Briefly explain the three stages of creep through creep curve.   | 8  |
| c.   | Explain dislocation climb mechanism of creep.  | 4  |

**UNIT - III**

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|------|--|----|
| 5 a. | Briefly explain Hume-Rothary rules for formation of solid solutions.                         | 10 |
| b.   | Explain the constructions of binary phase diagram by taking example of Nickel-Copper system. | 10 |
| 6 a. | Explain the construction of T-T-T diagram with a neat sketch.                                | 10 |
| b.   | Briefly explain the different equilibrium phases of iron and carbon system.                  | 10 |

**UNIT - IV**

- |      |  |    |
|------|--|----|
| 7 a. | Write the classification of heat treatment processes.  | 6  |
| b.   | What is hardenability? Explain Jominy end-Quench test for comparing hardenability of steels. | 10 |
| c.   | Describe partial Annealing process.  | 4  |

8. With a neat sketch explain the following :

- i) Pack carburising
- ii) Nitriding 20
- iii) Flame hardening
- iv) Induction hardening

**UNIT - V**

9. Write the composition, microstructure, properties and applications of the following :

- i) Gray Cast iron
- ii) White cast iron 20
- iii) Malleable Cast iron
- iv) Spheroidal Graphite iron

10. Write a note on the following :

- i) Magnesium alloys
- ii) Corrosion prevention by Cathodic protection 20
- iii) Corrosion prevention by alloying
- iv) Polarization

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