



# P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

**Third Semester, B.E. - Mechanical Engineering**

**Semester End Examination; March - 2021**

**Material Science and Metallurgy**

Time: 3 hrs

Max. Marks: 100

### Course Outcomes

The Students will be able to:

CO1: Explain the internal Structure of Crystalline Solid, Stacking of layers, Coordination Number and Atomic Packing Factor for different crystal structure, Crystal imperfections and diffusion.

CO2: Explain the concept of Stress and strain, Hardness and plastic deformation.

CO3: Analyze phase diagram and Iron Carbon Equilibrium diagrams.

CO4: Explain heat treatment process to improve the physical and mechanical properties of different types of engineering materials.

CO5: Explain the concept of corrosion and different methods of prevention of corrosion.

CO6: Explain microstructures and different types of alloys.

**Note:** I) PART - A is compulsory. Two marks for each question.

II) PART - B: Answer any **Two** sub questions (from a, b, c) for Maximum of **18 marks** from each unit.

Q. No.	Questions	Marks	BLs	COs	POs
<b>I : PART - A</b>		<b>10</b>			
I a.	Define Atomic Packing Factor (APF) and coordination number.	2			
b.	Define; i) Stiffness and ii) Tensile strength.	2			
c.	Describe Gibb's phase rule.	2			
d.	List out the different types of heat treatment process.	2			
e.	Define; i) Steel and ii) Composite materials.	2			
<b>II : PART - B</b>		<b>90</b>			
<b>UNIT - I</b>		<b>18</b>			
1 a.	Calculate APF for simple cubic and HCP crystal structure.	9			
b.	With a neat sketch, explain different types of point imperfections.	9			
c.	Explain different types of diffusion mechanisms with relevant sketches.	9			
<b>UNIT - II</b>		<b>18</b>			
2 a.	Explain plastic deformation by slip and twinning.	9			
b.	Explain RR Moore's fatigue testing with a neat diagram and illustrate S-N diagram.	9			
c.	Explain different stages in creep using a typical creep curve.	9			
<b>UNIT - III</b>		<b>18</b>			
3 a.	Describe Hume-Rothay's rules for the formation of solid solution.	9			
b.	Explain iron carbon equilibrium diagram with invariant reactions.	9			
c.	Explain TTT diagram.	9			

**UNIT - IV****18**

- 4 a. With a neat sketch, explain “Austempering and Martempering” process. 9
- b. Explain “Induction hardening” with a neat diagram. 9
- c. Explain “Pack carburizing” with a neat sketch. 9

**UNIT - V****18**

- 5 a. Outline the composition, properties and uses for;
  - i) Low carbon steel 9
  - ii) Medium carbon steel
  - iii) High carbon steel
- b. List and explain in detail the classification of composite materials. 9
- c. Explain “Pultrusion” process with a neat diagram. 9

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