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Ph.D Mechanical 2024-25 PYQP

Ph.D Mech Even sem 2024-25 QP

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2025-05-05

# PRINCIPLES OF PHYSICAL METALLURGY

Department of Mechanical Engineering – SEAS

SRM UNIVERSITY A.P

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**SRM UNIVERSITY – AP, ANDHRA PRADESH**

End Term Examination, May 2025

[Question Paper ID: 009147]

**Subject** : PRINCIPLES OF PHYSICAL METALLURGY  
**Title**  
**Batch** : 2023  
**Degree** : Ph.D  
**Branch** : Phy.

**Subject** : MCE 706  
**Code**  
**Max Marks** : 100  
**Duration** : 3 hours  
**QP Set** : ---

| Part A 10 x 2 = 20 marks Answer all questions (10 × 2 Marks = 20 Marks) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Marks BL |    | CO |
|-------------------------------------------------------------------------|-------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------|----------|----|----|
| Answer all Questions                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |    |    |
| 1.                                                                      | Calculate the atomic packing factor of an FCC unit cell                                                                                                                                                                                                                                                                                                                                                                                                           | 2        | 2  | 1  |
| 2.                                                                      | How interstitial solute atoms improve the strength of the metal                                                                                                                                                                                                                                                                                                                                                                                                   | 2        | 2  | 1  |
| 3.                                                                      | What is the effect of temperature on plastic behavior of metals?                                                                                                                                                                                                                                                                                                                                                                                                  | 2        | 2  | 1  |
| 4.                                                                      | Explain stacking fault with neat diagram?                                                                                                                                                                                                                                                                                                                                                                                                                         | 2        | 2  | 1  |
| 5.                                                                      | Explain cast structures, what is a dendrite?                                                                                                                                                                                                                                                                                                                                                                                                                      | 2        | 2  | 1  |
| 6.                                                                      | Explain, Low angle and High angle grain boundary                                                                                                                                                                                                                                                                                                                                                                                                                  | 2        | 2  | 1  |
| 7.                                                                      | Explain Directional solidification                                                                                                                                                                                                                                                                                                                                                                                                                                | 2        | 2  | 1  |
| 8.                                                                      | What is called as super saturated solid solution?                                                                                                                                                                                                                                                                                                                                                                                                                 | 2        | 2  | 1  |
| 9.                                                                      | Explain Martempering and Austempering?                                                                                                                                                                                                                                                                                                                                                                                                                            | 2        | 2  | 1  |
| 10.                                                                     | Define Hardenability                                                                                                                                                                                                                                                                                                                                                                                                                                              | 2        | 2  | 1  |
| Part B 5 x 16 = 80 marks Answer all questions (5 × 16 Marks = 80 Marks) |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   | Marks BL |    | CO |
| Answer all Questions                                                    |                                                                                                                                                                                                                                                                                                                                                                                                                                                                   |          |    |    |
| 11.                                                                     | 11(a) Explain briefly various crystal defects with neat diagram (16marks)<br><b>OR</b><br>11(b) (i) Derive the expression for the shear strength of perfect crystal. (12 marks)<br>(ii) Discuss the super plastic behavior in metals. (4 marks)                                                                                                                                                                                                                   | 16       | 16 | 1  |
| 12.                                                                     | 12(a) (i) Draw the Iron-Carbon equilibrium diagram and mark the temperatures, composition and phases. (12 marks)<br>(ii) Explain the different invariant reactions happens in Fe-C phase diagram (4 marks)<br><b>OR</b><br>12(b) (i)What is transformation induced plasticity? Write about its mechanical properties & microstructure of TRIP steel (8 marks)<br>(ii)What is Dual Phase steel? Write about its mechanical properties and microstructure (8 marks) | 16       | 16 | 2  |
| 13.                                                                     | 13(a) Explain the precipitation strengthening mechanism accounting to Age hardening, aging kinetics, mechanism etc. with neat diagram (16 marks)<br><b>OR</b><br>13(b) (i) Explain cold working & Annealing (4 marks)<br>(ii) Explain recovery, recrystallization and grain growth with neat diagram (16 marks)                                                                                                                                                   | 16       | 16 | 2  |

14. 14(a) Explain Nucleation and Growth, and derive expressions for Homogeneous and Heterogeneous nucleation (16 marks) **16** **16** **2** **2**

**OR**

- 14(b) (i) Explain the Mechanism of Slip and Twinning with neat diagram (8 marks)  
(ii) Explain Critical resolved shear stress with neat diagram (8 marks)

15. 15(a) (i) Explain Grain Boundary Strength and Hall Petch Relation with neat diagram (8 marks) **16** **16** **1** **5**  
(ii) Explain thermomechanical processing with suitable example (8 marks)

**OR**

- 15b (i) Explain Micro-alloyed steel (4 marks)  
(ii) Maraging steel (4 marks)  
(iii) Draw Time Temperature Transformation (TTT) for a eutectoid steel and label it appropriately (8 marks)

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