1. The atomic packing factor for the FCC crystal structure is (a) 0.53 (b) 0.68 (c) 0.74 (d) 0.82

2. (a) Tetragonal (b) Rhombohedral (c) Orthorhombic (d) Monoclinic crystal system shows
\[ a \neq b \neq c \quad \alpha = \gamma = 90^\circ \neq \beta \]

3. The Miller–Bravais indices for the plane shown below is (a) (1\,1\,10) (b) (1\,1\,01) (c) (1\,1\,01) (d) (0\,1\,01)

![Diagram of crystal structure]

4. The ASTM grain size number of a metal specimen is (a) 3.5 (b) 4 (c) 5.5 (d) 6.5 if 45 grains per square inch are measured at a magnification of 100×

5. For Hardness tests, using the indentation is called (a) Brinell, (b) Vickers (c) Knoop (d) Rockwell test

![Diagram of indentation hardness test]

6. A steel alloy (Young’s modulus = 207 GPa) to be used for a spring application must have a modulus of resilience of at least 2.07 MPa. What must be its minimum yield strength? (a) 925 (b) 975 (c) 1025 (d) 1200 MPa

7. Which one has the highest density of dislocation? (a) carefully solidified metal crystals (b) heavily deformed metals (c) ceramic (d) silicon wafer

8. How many slip systems in FCC crystal structure? (a) 6 (b) 8 (c) 12 (d) 16
9. \( \frac{a}{2} \langle 110 \rangle \) is the Burgers vector of (a) simple cubic (b) BCC (c) FCC (d) HCP

10. A copper–nickel alloy of composition 70 wt% Ni–30 wt% Cu is slowly heated from a temperature of 1300 °C. What is the composition of the last solid remaining prior to complete melting? (a) 59 (b) 70 (c) 78 (d) 100 wt% Ni

11. At 700 °C, what is the maximum solubility of Cu in Ag? (a) 0 (b) 6 (c) 95 (d) 100 wt% Cu
12. Which one is Bainite microstructure?

![Diagram showing Bainite microstructure]

13. Alternating layers of α ferrite and Fe₃C is called (a) spheroidite (b) pearlite (c) bainite (d) martensite

14. The minimum cation-to-anion radius ratio for the coordination number 3 is (a) 0.155 (b) 0.225 (c) 0.414 (d) 0.732

15. Zinc blende (ZnS) has crystal structure of (a) simple cubic (b) BCC (c) FCC (d) HCP

16. Which one is the repeat unit of Polytetrafluoroethylene?

![Diagram showing repeat units of Polytetrafluoroethylene]

17. One-half of an electrochemical cell consists of a pure nickel electrode in a solution of Ni²⁺ ions; the other half is a cadmium electrode immersed in a Cd²⁺ solution. The half-cell potentials for cadmium and nickel are, respectively, −0.403 V and −0.250 V. If the cell is a standard one, the generated voltage is (a) −0.653 (b) −0.153 (c) 0.153 (d) 0.653 V.

18. The band gap of silicon is around (a) 0.6 (b) 1.1 (c) 2.3 (d) 4.8 eV

19. What is the hole concentration in an N-type silicon wafer with $10^{15}$ cm$^{-3}$ of donors at room temperature? (a) $10^{20}$ (b) $10^{15}$ (c) $10^{10}$ (d) $10^5$ cm$^{-3}$

20. No visible light is absorbed by nonmetallic materials having band gap energies greater than about (a) 0.5 (b) 1.1 (c) 2.6 (d) 3.1 eV