

**M.I.E.T. ENGINEERING COLLEGE, TRICHY-07**  
**DEPARTMENT OF SCIENCE & HUMANITIES**  
**PH3251 – MATERIALS SCIENCE (R2021)**

**QUESTION BANK**

**UNIT – I -CRYSTALLOGRAPHY**

**PART-A**

1. What are the differences between crystalline and non-crystalline materials?
2. What is unit cell?.
3. What are Bravais Lattices?
4. What are Miller indices?
5. Define Burgers Vector.
6. Define Elastic Strain Energy.
7. What is plastic deformation?
8. Define Slip and Slip system.
9. What is polymorphism?
10. Define Linear density and Planar density.
11. Give the difference between Edge dislocation and Screw dislocation.
12. Define Phase and Phase change.
13. What is homogeneous nucleation and heterogeneous nucleation?

**PART-B**

1. Explain the Characteristics of BCC and FCC structures with a neat diagram (16)
2. Explain the Characteristics of Hexagonal Closely Packed Crystal System (HCP) with a neat diagram. (16)
3. Write a short note on point defects (8)
4. Explain (i) Edge dislocation (ii) Screw dislocation (iii) Grain Boundary (iv) Twin Boundary (16)
5. Write short note on Plastic deformation of materials.(8)
6. Write a short note on (i) Polymorphism  
(ii) Phase changes
7. Explain nucleation and growth and explain about (i) Homogeneous nucleation and (ii) Heterogeneous nucleation. (16)

**UNIT – II-ELECTRICAL AND MAGNETIC PROPERTIES OF MATERIALS**

**PART-A**

1. Define the Terms: Drift velocity and Mobility of electron.
2. Define Relaxation time and Collision time.
3. Define Drift Current Density.

4. State Wiedmann-Franz Law and Mention Lorentz Number.
5. What is relaxation time and collision time?
6. What are the drawbacks of classical free electron theory?
7. What is tunneling?
8. Define degenerate states.
9. What is Fermi Distribution Function?
10. Define Fermi level and Fermi Energy.
11. What is Periodic Potential?
12. What is an effective mass of electron?
13. Define Magnetic dipole moment.
14. Define the terms : (i) Magnetic Permeability (iv) Magnetic Susceptibility
15. What is Bohr Magneton?
16. State Curie – Weiss law.
17. What are quantum interference devices?
18. What is Giant magneto resistance (GMR) sensor?

### **PART-B**

1. Derive an expression for electrical conductivity and thermal conductivity of conducting Materials. Deduce the Wiedemann – Franz law from it.(16)
2. Define Fermi Function. Explain the effect of temperature on Fermi function. (8)
3. Define density of states. Derive an expression for the density of states in a cubical Metal. (16)
4. Write a short note on (i) Electrons in a periodic potential. (8)  
(ii) Tight binding approximation in solids. (8)
5. Derive an expression for the effective mass of an electron and concept of hole. (16)
6. Explain the properties of Dia, Para and Ferro magnetic materials. (16)
7. Explain Para magnetism in conduction electrons in metals. (8)
8. Discuss the Origin and exchange interaction of ferromagnetism.(8)
9. Write a short note on quantum interference devices.(8)
10. Describe working of GMR devices. (16)

## **UNIT – III- SEMICONDUCTORS AND TRANSPORT PHYSICS**

### **PART-A**

1. What are the properties of semiconductors?
2. What are the differences between Indirect band gap and Direct band gap semiconductors?
3. What are the differences between intrinsic and extrinsic semiconductors?
4. What are the differences between n-type and p-type semiconductors?
5. Define Drift current and Diffusion current.
6. Define Hall effect.

7. What are Hall Devices?
8. What are the difference between Ohmic diode and Schottky diode?
9. What are applications of schottky diode?

### **PART-B**

1. Obtain an expression for carrier concentration in an intrinsic semiconductor and also calculate the intrinsic carrier concentration. (16)
2. Derive an expression for density of electrons in the conduction band of an n – type semiconductor and explain the variation of Fermi level with temperature and donor concentration. (16)
3. Derive an expression for density of holes in the valence band of an p – type semiconductor and explain the variation of Fermi level with temperature and acceptor concentration. (16)
4. Explain the working principle of (i) Gauss Meter (ii) Electronic Multimeter and (iii) Electronic Wattmeter (16)
5. Describe the construction and working principle of Ohmic contact diode.(12)
6. Describe the construction and working principle of Schottky diode. Give its advantages, disadvantages and applications. (16)

## **UNIT – IV- OPTICAL PROPERTIES OF MATERIALS**

### **PART – A**

1. What are Optical materials. Give their types.
2. What is absorption of light in semiconductor?
3. What is carrier generation and recombination?
4. Define Carrier Injection.
5. What is optical gain and optical loss?
6. What is quantum well?
7. What are opto-electronic devices?
8. What is (i) photo diode (ii) solar cell?
9. What is (i) LED (ii) OLED?
10. What is Excitonic state?
11. What is Electro optics and Non Linear optics?
12. What are modulators?
13. What are optical switching devices?
14. Define Plasmonics.

### **PART – B**

1. Explain different types of optical materials.(8)
2. Explain optical absorption and emission in semiconductors.(8)
3. Write a short note on charge injection and recombination.(8)
4. Write a short note on optical loss and optical gain.
5. Explain the principle, construction and working of (i) P-N photo diode (ii) Solar cell(16)

6. Explain the construction and working of a (i) LED (ii) OLED.(16)
7. Explain the construction and working of a Laser Diode. Give their advantages, Dis advantages and applications. (16)
8. Explain optical process in semiconductor devices.(8)
9. Write a short note on Excitonic state. (8)
10. Explain the working principle of Electro-Optic Modulator.
11. Explain the working principle of Self Electro optic Effect Devices (SEED) (16)
12. Write a short note on Plasmonics. (12)

### **UNIT – V- NANOELECTRONIC DEVICES**

#### **PART – A**

1. What is quantum confinement?
2. What is Quantum well and Quantum wire?
3. What is Zener Bloch Oscillation?
4. What is Resonant tunneling?
5. Define quantum interference.
6. Define Mesoscopic structure.
7. Define Single Electron phenomena.
8. Define Coulomb energy and Coulomb Blockade effect.
9. What is SET?
10. What are semiconductor photonic structure?
11. Define 1D,2D and 3D photonic crystal.
12. What are active and passive opto-electronic devices?
13. Define photo process.
14. What is Spintronics?
15. What is Carbon Nano Tube? Give their types?
16. What are the properties of CNT?
17. What are the applications of CNT?

#### **PART – B**

1. Write a short note on Quantum confinement and Quantum structures. (16)
2. Write a short not on Zener Bloch Oscillations.(12)
3. Explain about the concept of Resonant tunneling. (12)
4. Write a short note on Mesoscopic structures. (8)
5. Describe Construction and Working of Single Electron Tansistor ang give their advantages and applications.(16)
6. Explain in detail about Semiconductor photonic Structures and their types. (16)
7. Explain about active and passive photonic devices. (12)
8. Write a short note on photo process. (8)
9. Explain in detail about spintronics. (16)
10. What are Carbon Nano Tubes? Give their types, properties and applications.