**Q. Code:963455**

**Reg. No.** | | | | | | | | | | | | | |

# B.E. / B. TECH DEGREE EXAMINATIONS - MAY 2024

Second Semester

## PH22252 – PHYSICS OF MATERIALS

*(Common to EC & EE)*

**(Regulation 2022)**

**TIME: 3 HOURS** **MAX. MARKS: 100**

| COURSE OUTCOMES | STATEMENT | RBT LEVEL |
|---|---|---|
| **CO 1** | Comprehend the behavior of electrons in solids. | **2** |
| **CO 2** | Demonstrate an understanding of various properties of Semiconducting materials and their internal structure. | **3** |
| **CO 3** | Analyses the properties of dielectric materials and apply them in various fields. | **3** |
| **CO 4** | Summarize the basics of magnetism and superconductivity. Explore a few of their technological applications. | **2** |
| **CO 5** | Develop an understanding the Fundamentals of Electronic Science and its applications. | **3** |

**PART- A (20 x 2 = 40 Marks)**

(Answer all Questions)

| | | CO | RBT LEVEL |
|---|---|---|---|
| **1.** | What is drift velocity? how is it different from the thermal velocity of an electron? | **1** | **2** |
| **2.** | How does the electrical resistivity of a metal vary with temperature? | **1** | **2** |
| **3.** | What are the main drawbacks of classical free electron theory? | **1** | **2** |
| **4.** | Write the significance of the Fermi-Dirac distribution function. | **1** | **2** |
| **5.** | The intrinsic carrier density at room temperature in Ge is $2.37x10^{-19}/m^3$. If the electron and hole mobilities are 0.38 and 0.18 $m^2V^{-1}s^{-1}$ respectively, calculate the resistivity. | **2** | **3** |
| **6.** | Compared with Germanium, silicon is widely used to manufacture electronic devices. Why? | **2** | **3** |
| **7.** | Distinguish between elemental and compound semiconductors. | **2** | **3** |
| **8.** | In what way Schottky diode disadvantageous from that of the P-N Junction diode? | **2** | **3** |
| **9.** | How temperature effects the polarization of dielectrics? | **3** | **3** |
| **10.** | The atomic radius of germanium is 0.122 nm. Determine its electronic polarizability. | **3** | **3** |
| **11.** | Give the difference between polar and non-polar dielectrics | **3** | **2** |
| **12.** | Mention the different mechanisms involved in dielectric breakdown. | **3** | **2** |

| | | | |
|---|---|---|---|
| **13.** | What are Cooper pair of electrons? | **4** | **2** |
| **14.** | Calculate the critical current which can flow through a long thin superconducting wire of diameter 1 mm. The critical magnetic field is $7.9 \times 10^3$ $Am^{-1}$. | **4** | **2** |
| **15.** | How will you differentiate magnetic materials based on their spin alignment? | **4** | **2** |
| **16.** | Why are ferrites advantageous for use as transformer cores? | **4** | **2** |
| **17.** | Mention any two advantages of JFET. | **5** | **2** |
| **18.** | What are spintronics? | **5** | **2** |
| **19.** | Design OR gate using transistor. | **5** | **3** |
| **20.** | How gray code differs from binary code? | **5** | **3** |

## PART- B (5 x 10 = 50 Marks)

| | | | Marks | CO | RBT LEVEL |
|---|---|---|---|---|---|
| **21. (a)** | | Based on classical free electron theory, derive an expression for the electrical conductivity of metal and find expression for Lorentz number. | **(10)** | **1** | **2** |
| | | **(OR)** | | | |
| **(b)** | | Explain the meaning of density of states. Derive an expression for the number of allowed states for unit volume of a solid. | **(10)** | **1** | **2** |
| **22. (a)** | **(i)** | Assume the Fermi –Dirac distribution and derive an expression for the concentration of electrons per unit volume in the conduction band of an intrinsic semiconductor. | **(8)** | **2** | **3** |
| | **(ii)** | Briefly discuss the variation of Fermi level with temperature in the case of an intrinsic semiconductor. | **(2)** | **2** | **3** |
| | | **(OR)** | | | |
| **(b)** | **(i)** | Discuss Hall effect in p-type and n-type semiconductors. | **(6)** | **2** | **3** |
| | **(ii)** | Derive an expression for Hall Coefficient. | **(4)** | **2** | **3** |
| **23. (a)** | **(i)** | Name the different types of polarization mechanisms that can take part in the presence of an electric field in dielectric materials. | **(2)** | **3** | **3** |
| | **(ii)** | Obtain an expression for electronic and ionic polarization in dielectrics. | **(8)** | **3** | **3** |
| | | **(OR)** | | | |
| **(b)** | **(i)** | Explain the frequency and temperature dependence of different polarization mechanisms. | **(6)** | **3** | **3** |
| | **(ii)** | List any four applications of ferroelectric materials. | **(4)** | **3** | **3** |
| **24. (a)** | | Briefly explain the following | **(2+4** | **4** | **2** |

a) Cryotron +4)
b) Magnetic Levitation
c) High Temperature superconductors

**(OR)**

| | | | | | |
|---|---|---|---|---|---|
| **(b)** | **(i)** | Differentiate Soft and Hard magnetic materials. | **(6)** | **4** | **2** |
| | **(ii)** | Draw a B-H curve for a ferromagnetic material and identify retentivity and coercive fields on the curve. | **(4)** | **4** | **2** |
| **25. (a)** | | With a neat diagram explain the working and output characteristics of JFET. | **(10)** | **5** | **3** |

**(OR)**

| | | | | | |
|---|---|---|---|---|---|
| **(b)** | | Simplify using K-map Y = F(A,B,C,D) = Σ (0,1,3,5,7,9,11,12,13,14,15) in sum of products. | **(10)** | **5** | **3** |

**PART- C (1 x 10 = 10 Marks)**

(Q.No.26 is compulsory)

| | | | **Marks** | **CO** | **RBT LEVEL** |
|---|---|---|---|---|---|
| **26.** | | Explain the term internal field in solids. Derive an expression for the Lorentz field for elemental dielectrics. | **(10)** | **3** | **3** |

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