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**Bengaluru**

**School of Engineering &**

**School of Computer Science and Engineering**

**End - Term Examinations – January 2025**

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| **Semester**: I | **Date**: 08/01/2025 |
| **Course Code**: PHY1002 | **Time**: 01:00 pm – 04:00pm |
| **Course Name**: Optoelectronics and Device Physics | **Max Marks**: 100 |
| **Program:** B.Tech-First Year | **Weightage**: 50% |

**Instructions:**

1. *Read all questions carefully and answer accordingly.*
2. *Do not write anything on the question paper other than roll number.*

**Part A**

|  |  |  |  |  |
| --- | --- | --- | --- | --- |
| **Answer ALL the Questions. Each question carries 2marks. 2Mx10Q=20M** | | | | |
| **1** | How is the Fermi level related to intrinsic and extrinsic semiconductors? | **2 Marks** | **L** | **CO1** |
| **2** | Write any two applications of Zener diode | **2 Marks** | **L** | **CO2** |
| **3** | Mention the types of transistors and give one application | **2 Marks** | **L** | **CO2** |
| **4** | Explain the principal of solar cell | **2 Marks** | **L** | **CO2** |
| **5** | Write the postulates of Planck’s theory | **2 Marks** | **L** | **CO3** |
| **6** | Calculate the de Broglie wavelength associated with an electron accelerated under a potential difference of 1000 V. | **2 Marks** | **L** | **CO3** |
| **7** | Find the uncertainty in the momentum of an electron if uncertainty in its position is 10 nm. | **2 Marks** | **L** | **CO3** |
| **8** | Define induced absorption | **2 Marks** | **L** | **CO4** |
| **9** | Define numerical aperture and write the mathematical expression for it | **2 Marks** | **L** | **CO4** |
| **10** | What is the life time atom in the metastable state | **2 Marks** | **L** | **CO4** |

**Part B**

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| **Answer ALL Questions. Each question carries 20 marks. 4QX20M=80M** | | | | | |
| **11** | **11a** | Explain the classification of solids on the basis of band theory with suitable energy level diagrams | **10Marks** | **L** | **CO1** |
| **11b** | Compute the concentration of intrinsic charge carriers in a Ge crystal at 27 OC. Given that Eg = 0.75 eV and assume that me=mh | **10Marks** | **L** | **CO1** |
| **Or** | | | | | |
| **12** | **12a** | When a current-carrying conductor or a semiconductor is introduced to a perpendicular magnetic field, a voltage can be measured at the right angle to the current path. Identify the effect and explain the possible parameters | **10Marks** | **L** | **CO1** |
| **12b** | Differentiate the soft and hard superconductors with suitable magnetic field vs magnetization graphs | **10Marks** | **L** | **CO1** |
|  |  |  |  |  |  |
| **13** | **13a** | Name the device which produces electricity when light fall on it. Explain in detail about the principle, construction and working of it with suitable diagrams. | **10Marks** | **L** | **CO2** |
| **13b** | Explain the principle and working of an LED and what will be the wavelength of the light produces when an Indium Gallium Nitride (InGaN) semiconductor has a band gap of 2.9 eV. | **10Marks** | **L** | **CO2** |
| **Or** | | | | | |
| **14** | **14a** | Explain the characteristics of a p-n junction under forward and reverse bias conditions. | **10Marks** | **L** | **CO2** |
| **14b** | Explain the operation of a Zener diode in both reverse bias and forward bias, with the aid of an I-V characteristics graph | **10Marks** | **L** | **CO2** |
|  |  |  |  |  |  |
| **15** | **15a** | Define matter waves and derive an expression for de-Broglie wavelength associated with an electron, and in terms of energy of the particle | **10Marks** | **L** | **CO3** |
| **15b** | Compare the energy of a photon with that of a neutron when both are associated with a de Broglie wavelength of 1 Å. Given mass of neutron is 1.674 x 10-27 kg | **10Marks** | **L** | **CO3** |
| **Or** | | | | | |
| **16** | **16a** | Define Heisenberg’s Uncertainty Principle and calculate the position and momentum of a 10 k e V electron are determined simultaneously. If its position is located within 1 Å, what is the percentage of uncertainty in its momentum? | **10Marks** | **L** | **CO3** |
| **16b** | Mention the properties of matter waves and calculate the momentum of an electron and the de Broglie wavelength associated with it if its kinetic energy is 1.8 KeV. | **10Marks** | **L** | **CO3** |
|  |  |  |  |  |  |
| **17** | **17a** | Describe the different ways in which radiation interacts with matter (absorption and types of emission) with suitable energy level diagrams. | **10Marks** | **L** | **CO4** |
| **17b** | Differentiate ordinary light and laser and find the population of the two states in a diode Laser that produces a light of wavelength 6000 Å at 27°C. | **10Marks** | **L** | **CO4** |
| **Or** | | | | | |
| **18** | **18a** | Define the principle of optical fibers. Draw a block diagram of a point-to-point communication system using optical fibers and explain its components. | **10Marks** | **L** | **CO4** |
| **18b** | Mention the advantages of optical fibers and calculate the numerical aperture, critical angle and acceptance angle in an optical fibre. Refractive indices of core and cladding are respectively 1.41 and 1.4. Wavelength of laser used is 820 n m | **10Marks** | **L** | **CO4** |