Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

Mid - Term Examinations – MARCH 2026

Date: 11-03- 2026 **Time:** 09:30am – 11:00am

School: SOCSE	**Program:** B Tech	
Course Code : PHY2501	**Course Name:** Optoelectronics and Quantum Physics	
Semester: II	**Max Marks**: 50	**Weightage**:25%

CO - Levels	CO1	CO2	CO3	CO4	CO5	CO6
Marks	26	24				40

Instructions:

(i) Read all questions carefully and answer accordingly.

(ii) Do not write anything on the question paper other than roll number.

(iii) Given : Planck's constant $h = 6.625\times10^{-34}$ Js; Boltzmann's constant $k_B = 1.38\times10^{-23}$ J/K , Speed of light $c = 3\times10^{8}$ m/s, Mass of the electron $m = 9.1\times10^{-31}$ kg, Charge of the electron $e = 1.6\times10^{-19}$ C

Part A

Answer ALL the Questions. Each question carries 2marks. **5Q x 2M=10M**

1	An electronic circuit requires a device that maintains constant voltage even when input voltage fluctuates, Identify the suitable type of the semiconductor.	**2 Marks**	**L2**	**CO1**
2	Determine the wavelength of light emitted from LED which is made up of GaAsP semiconductor whose forbidden energy gap is 1.875 eV.	**2 Marks**	**L3**	**CO1**
3	Describe superconductivity and discuss the importance of critical temperature.	**2 Marks**	**L2**	**CO1**
4	Explain Schrodinger's time independent wave equation and state its physical meaning.	**2 Marks**	**L2**	**CO2**
5	Illustrate the identity matrix and present its representation for a 2 × 2 system.	**2 Marks**	**L3**	**CO2**

Part B

Answer the Questions. **Total Marks 40M**

6.	**a.**	A home is planning to install a solar panel system to reduce electricity cost. Apply your knowledge of solar cells to explain how the solar cell will generate electricity. Use the principle, construction, working, and efficiency concepts in your explanation.	**10 Marks**	**L3**	**CO1**
	b.	Differentiate intrinsic and extrinsic semiconductors. In a P-type germanium, $n_i = 2.1 \times 10^{19}$ m^{-3}density of boron 4.5×10^{23} atoms /m^3. The electron and hole mobility are $0.4 m^2 v^{-1} s^{-1}$ and 0.2 $m^2 v^{-1} s^{-1}$ respectively. Find its conductivity before and after addition of boron atoms.	**10 Marks**	**L3**	**CO6**
		Or			
7.	**a.**	Apply the principle of Hall effect to determine whether a given current carrying semiconductor placed in a perpendicular magnetic field is n-type or p-type, and use appropriate diagrams and mathematical expressions for Hall voltage and Hall coefficient to support your explanation. Calculate the Hall voltage when a conductor carrying a current of 100 A, is placed in a magnetic field of 1.5 T. The conductor has a thickness of 1 cm, and the number density of charges inside the conductor is 5.9×10^{28} /m^3.	**10 Marks**	**L3**	**CO1**
	b.	A paramagnetic material has a magnetic field intensity of 10^4 Am^{-1}. If the susceptibility of the material at room temperature is 3.7×10^{-5}. Calculate the magnetization and flux density in the material. Apply your understanding of superconducting materials to compare and distinguish between soft superconductors and hard superconductors based on their properties and applications.	**10 Marks**	**L3**	**CO6**

8.	**a.**	Apply the concept of Heisenberg's Uncertainty Principle to explain its physical significance with suitable examples, describe the important properties of a wave function. What is the minimum uncertainty in the energy state of an atom if an electron remains in this state for 10^{-8} s.	**10 Marks**	**L2**	**CO2**
	b.	An electron in a molecule travel at a speed of 40 m/s. The uncertainty in the momentum Δp of the electron is 10^{-6} of its	**10 Marks**	**L3**	**CO6**

		momentum. Compute the uncertainty in position Δx if the mass of an electron is 9.1×10^{-31} kg. Mention the properties of matter waves			
		Or			
9.	**a.**	Apply your knowledge of Pauli matrices to demonstrate their properties and use suitable examples to illustrate their operations.	**10 Marks**	**L3**	**CO2**
	b.	Let $\|u_1\rangle$, $\|u_2\rangle$, $\|u_3\rangle$ be an orthonormal basis. In this basis, define $\|\alpha\rangle=i\|u_1\rangle+2\|u_2\rangle-(1+i)\|u_3\rangle$ $\|\beta\rangle=3\|u_1\rangle-i\|u_2\rangle+2\|u_3\rangle$ (a) Find $\langle\alpha\|$ and $\langle\beta\|$. (b) Compute $\langle\alpha\|\beta\rangle$ and verify that $\langle\alpha\|\beta\rangle = \langle\beta\|\alpha\rangle^*$. (c) If $b = 1 + 2i$, compute $\|b\alpha\rangle$. (d) Find $\|\alpha + \beta\rangle$ and $\|\alpha - \beta\rangle$.	**10 Marks**	**L3**	**CO6**