Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

Mid - Term Examinations – MARCH 2026

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

School: SOE	**Program:** B.Tech (ECE,EEE)	
Course Code : PHY2502	**Course Name:** Advanced Materials and Quantum Physics for Engineers	
Semester: II	**Max Marks**: 50	**Weightage**: 25%

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**
Marks	**24**	**26**	**-**	**-**	**-**

Instructions:

(i) Read all questions carefully and answer accordingly.

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

Part A

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

1	Based on the given energy bandgap values — Carbon (5 eV), Silicon (1.11 eV), Germanium (0.67 eV), and Tin (0 eV) — classify these materials as conductors, semiconductors, or insulators.	**2 Marks**	**L3**	**CO1**
2	A superconducting tin has a critical temperature of 3.7 K at zero magnetic field and a critical field of 0.0306 Tesla at 0 K. Find the critical field at 2 K.	**2 Marks**	**L3**	**CO1**
3	Apply de-Broglie hypothesis to calculate the wavelength of an electron accelerated through 150 V	**2 Marks**	**L3**	**CO2**
4	Given two state vectors $\|\psi_1\rangle = \begin{pmatrix}1\\0\end{pmatrix}$ and $\|\psi_2\rangle = \begin{pmatrix}0\\1\end{pmatrix}$, apply inner product concept to determine whether the states are orthogonal.	**2 Marks**	**L3**	**CO2**
5	A particle has momentum $p = 4 \times 10^{-24}$ kg m s^{-1}. Apply de-Broglie relation to find its wavelength.	**2 Marks**	**L3**	**CO2**

Part B

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

6.	**a.**	Apply the photovoltaic effect to explain the construction and working of a solar cell. A solar cell of dimensions 10 cm × 10 cm produces 0.5 V and 2.5 A under an incident solar intensity of 800 W/m^2.Determine the efficiency of the solar cell using the given data.	**10 Marks**	**L3**	**CO1**
	b.	Using the Hall effect, describe the setup and operation of a semiconductor sample with a neat diagram. For silicon, the measured Hall coefficient is $-\mathbf{7.35 \times 10^{-5}}\ m^3C^{-1}$. (a) Determine whether the semiconductor is n-type or p-type. (b) If the conductivity is $\mathbf{200\ \Omega^{-1}m^{-1}}$, evaluate the density and mobility of charge carriers.	**10 Marks**	**L3**	**CO1**
		Or			
7.	**a.**	Apply the concept of dielectric polarization to distinguish between electronic, ionic, orientational, and space-charge polarization.	**10 Marks**	**L3**	**CO1**
	b.	Apply the working principle of a Light Emitting Diode (LED) to explain its construction and operation. An LED emits light of wavelength 620 nm. Calculate the energy band gap of the semiconductor material.	**10 Marks**	**L3**	**CO1**

8.	**a.**	i) 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 1.674×10^{-27} kg ii) Apply Schrödinger's Cat concept to explain the idea of quantum superposition.	**10 Marks**	**L3**	**CO2**
	b.	i)Apply de Broglie theory to derive the expression for wavelength of a free particle in terms of its kinetic energy. ii)Apply de Broglie hypothesis to derive the expression for the wavelength of an electron accelerated through a potential difference $\boldsymbol{V}$ iii) An electron is accelerated through 250 V. Calculate its de Broglie wavelength.	**10 Marks**	**L3**	**CO2**

		Or			
9.	**a.**	Suppose that $\|u_1\rangle$, $\|u_2\rangle$, $\|u_3\rangle$ is an orthonormal basis. In this basis let, $$\|\psi\rangle = 2i\,\|u_1\rangle - 3\,\|u_2\rangle + i\,\|u_3\rangle$$ $$\|\phi\rangle = 3\,\|u_1\rangle - 2\,\|u_2\rangle + 4\,\|u_3\rangle$$ (a) Find $\langle\psi\|$ and $\langle\phi\|$. (b) Compute the inner product $\langle\phi\,\|\psi\,\rangle$ and show that $\langle\phi\,\|\psi\,\rangle = \langle\psi\,\|\phi\rangle^*$. (c) Let $a = 3 + 3i$ and compute $\|a\psi\rangle$. (d) Find $\|\psi + \phi\rangle$, $\|\psi - \phi\rangle$.	**10 Marks**	**L3**	**CO2**
	b.	Two vectors in a three-dimensional complex vector space are defined by: $$\|A\rangle = \begin{pmatrix} 2 \\ -7i \\ 1 \end{pmatrix}, \|B\rangle = \begin{pmatrix} 1+3i \\ 4 \\ 8 \end{pmatrix}$$ Let $a = 6 + 5i$ (a) Compute $a\,\|A\rangle$, $a\,\|B\rangle$, and $a(\|A\rangle + \|B\rangle)$. Show that $a(\|A\rangle + \|B\rangle) = a\,\|A\rangle + a\,\|B\rangle$. (b) Find the inner products $\langle A\|B\rangle$, $\langle B\|A\rangle$.	**10 Marks**	**L3**	**CO2**