Roll No.												

PRESIDENCY UNIVERSITY

BENGALURU

Mid - Term Examinations – October 2025

Date: 11-10-2025 **Time:** 02.00pm to 03.30pm

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

CO - Levels	**CO1**	**CO2**	**CO3**	**CO4**	**CO5**	**CO6**
Marks	**53**	**32**	**-**	**-**	**-**	**5**

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 = 6.625×10^{-34} Js; Boltzmann's constant k_B = 1.38×10^{-23} J/K , Speed of light c = 3×10^{8} m/s, Mass of the electron m = 9.1×10^{-31} kg, Charge of the electron e =1.6×10^{-19} C

Part A

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

1	Differentiate between conductors, semiconductors, and insulators based on band gap	**2 Marks**	**L2**	**CO1**
2	Define superconductivity and mention one important application.	**2 Marks**	**L2**	**CO1**
3	Superconductivity disappears above the critical temperature. what happens to Cooper pairs as the material returns to normal state.	**2 Marks**	**L2**	**CO1**
4	An electron is accelerated through potential difference V such that the final momentum becomes twice the initial momentum. Determine how the De-broglie wavelength changes.	**2 Marks**	**L2**	**CO2**
5	An LED emits light of wavelength λ=620 nm. Calculate the band gap energy of the semiconductor in eV.	**2 Marks**	**L2**	**CO1**

Part B

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

6.	**a.**	Define Fermi energy and represent the position of Fermi level in intrinsic, n-type, and p-type semiconductors.**(5 Marks)**	**10 Marks**	**L2**	**CO1**
	b.	The Intrinsic carrier density at room temperature in Ge is 2.37×10^{19} m^{-3} . If the electron and hole mobilities are 0.38 $m^2 V^{-1} s^{-1}$ and 0.18 $m^2 V^{-1} s^{-1}$ respectively, estimate the resistivity. **(5 Marks)**		**L3**	
		Or			
7.	**a.**	Define superconductivity and explain the Meissner effect. **(5 Marks)**	**10 Marks**	**L2**	**CO1**
	b.	A superconductor has a critical temperature of 7.2 K at zero magnetic field. If the critical field at 0 K is 0.3 T, calculate the critical field at 4 K. **(5 Marks)**		**L3**	

8.	**a.**	State the de-Broglie hypothesis and derive the expression for de-Broglie wavelength. **(5 Marks)**	**10 Marks**	**L2**	**CO2**
	b.	The trotting speed of an elephant is 10 m/s. Calculate the associated de Broglie. wavelength. (Mass of the elephant = 1000 kg). **(5 Marks)**		**L3**	
		Or			
9.	**a.**	Derive the de Broglie wavelength of a free particle in terms kinetic energy and for an electron accelerated through a potential difference V. **(5 Marks)**	**10 Marks**	**L2**	**CO2**
	b.	Calculate the de-Broglie wavelength of an electron accelerated by a potential difference of 200 V. **(5 Marks)**		**L3**	

10.	**a.**	Explain the principle, construction and working of a solar cell. (**5 Marks)**	**10 Marks**	**L2**	**CO1**
	b.	A solar cell has I_{sc} = 40mA, V_{oc} = 0.6V, and maximum power point at V_{max} = 0.5V, $I_{Max=}$ 30mA calculate fill factor. (**5 Marks)**		**L3**	
		Or			
11.	**a.**	Explain Hall effect and analyze how the Hall effect can be used to identify the given semiconductor type. **(5 Marks)**	**10 Marks**	**L2**	**CO1**
	b.	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		**L3**	

		inside the conductor is 5.9×10^{28} /m^3. **(5 Marks)**			

12.	**a.** **b.**	Explain the Characteristics of Matter waves. **(5 Marks)** 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 . **(5 Marks)**	**10 Marks**	**L2** **L3**	**CO2**
		Or			
13.	**a.** **b**	Differentiate between n-type and p-type semiconductors and why n-type conductivity slightly higher compare to p-type? **(5 Marks)** Analyze the differences between Type-I and Type-II superconductors. Which type of superconductor should be used to create high magnetic field and why? **(5 Marks)**	**10 Marks**	**L2** **L4**	**CO1** **CO6**