



PRESIDENCY UNIVERSITY

BENGALURU

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End - Term Examinations – May/June 2026

Date: 18- 05-2026

Time: 09:30am – 12:30pm

School: SOE	Program: B.Tech (ECE,EEE)	
Course Code: PHY2502	Course Name: Advanced Materials and Quantum Physics for Engineers	
Semester: II	Max Marks: 100	Weightage: 50%

CO - Levels	CO1	CO2	CO3	CO4	CO5
Marks	22	26	16	12	24

Instructions:

- (i) Read all questions carefully and answer accordingly.
- (ii) Do not write anything on the question paper other than roll number.
- (iii) Given : $h = 6.625 \times 10^{-34} \text{ Js}$, $k_B = 1.38 \times 10^{-23} \text{ J/K}$, $c = 3 \times 10^8 \text{ m/s}$, $\mu_0 = 4\pi \times 10^{-7} \text{ H/m}$,
 $m_e = 9.1 \times 10^{-31} \text{ kg}$, $e = 1.6 \times 10^{-19} \text{ C}$, $\epsilon_0 = 8.854 \times 10^{-12} \text{ Fm}^{-1}$

Part A

Answer ALL the Questions. Each question carries 2marks.

10Q x 2M=20M

1.	What is doping in semiconductors? Mention few elements commonly used for P-type doping.	2 Marks	L2	CO1
2.	Which device converts electrical energy into light energy?	2 Marks	L2	CO1
3.	Mention the mathematical condition for the vectors to be called orthogonal vectors.	2 Marks	L2	CO2
4.	What are Hermitian Matrices?	2 Marks	L2	CO2
5.	Write the matrix representation of any two Pauli matrices?	2 Marks	L2	CO2
6.	Which equation mathematically implies the non-existence of magnetic monopoles?	2 Marks	L2	CO3
7.	State the mathematical condition for a vector field to be called an irrotational field.	2 Marks	L2	CO3

8.	What is meant by displacement current? How does it differ from conduction current	2 Marks	L2	C04
9.	What is the physical significance of numerical aperture?	2 Marks	L2	C05
10.	What kind of emission differentiates laser light from ordinary light?	2 Marks	L2	C05

Part B

Answer the Questions.

Total Marks 80M

11.	a.	Explain the Meissner effect with neat diagram. 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	10 Marks	L3	C01
	b.	With a neat diagram, explain the principle, construction, and working of a solar cell. Draw its I-V characteristics under illumination and define short-circuit current, open-circuit voltage, efficiency and fill factor.	10 Marks	L3	C01

Or

12.	a.	Discuss the different types of polarization in dielectric materials. Mention the types of polarizations which are independent of temperature.	10 Marks	L3	C01
	b.	Discuss Hall effect in a semiconductor with neat diagram. The Hall coefficient of certain silicon specimen was found to be $-7.35 \times 10^{-5} \text{ m}^3 \text{ C}^{-1}$ from 100 to 400 K. Determine the nature of the semiconductor. If the conductivity was found to be $200 \text{ ohm}^{-1} \text{ m}^{-1}$. Estimate the density and mobility of the charge carrier.	10 Marks	L3	C01

13.	a.	Mention the characteristic properties of matter waves. Compute the de Broglie wavelength for a neutron moving with one tenth part of velocity of light, given mass of neutron = $1.674 \times 10^{-27} \text{ kg}$.	10 Marks	L3	C02
	b.	Derive an expression for de Broglie wavelength of electron accelerated by a potential. Calculate the momentum of an electron and the de Broglie wavelength associated with it if its kinetic energy is 1.5 KeV.	10 Marks	L3	C02

Or

14.	a.	Show that the vectors $ \psi\rangle = \begin{pmatrix} \frac{1}{\sqrt{2}} \\ \frac{1}{\sqrt{2}} \end{pmatrix}, \phi\rangle = \begin{pmatrix} \frac{1}{\sqrt{2}} \\ -\frac{1}{\sqrt{2}} \end{pmatrix}$ are orthogonal. Is $\psi\rangle$ normalized? A vector $u\rangle = \begin{pmatrix} x \\ 3x \\ -2x \end{pmatrix}$ where x is an unknown real number. Find x such that $u\rangle$ is normalized.	10 Marks	L3	C02
	b.	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	C02

15.	a.	Describe the Cylindrical coordinate system with a neat diagram. Explain physical significance of gradient of a scalar field. Find $\nabla\phi$ for $\phi(x, y, z) = x^2 + 2y^2 + 3z^2$ at point $P(1, 1, 1)$.	10 Marks	L3	C03
	b.	Explain the physical significance of divergence and curl of a vector field. For $\vec{F}(x, y, z) = x^2\hat{i} + y^2\hat{j} + z^2\hat{k}$, find $\nabla \cdot \vec{F}$ at $P(2,1,3)$. For $\vec{F}(x, y, z) = yz\hat{i} + xz\hat{j} + xy\hat{k}$, find $\nabla \times \vec{F}$	10 Marks	L3	C03
Or					
16.	a.	Explain Gauss Divergence theorem Verify Gauss' divergence theorem for the vector field $A = x^2\hat{i} + y^2\hat{j} + z^2\hat{k}$ over the cube $0 \leq x \leq a, 0 \leq y \leq a, 0 \leq z \leq a$.	10 Marks	L3	C03
	b.	Derive the electromagnetic wave equation and show that light is an electromagnetic wave. Calculate the wavelength of an electromagnetic wave in vacuum if its frequency is 100 Hz	10 Marks	L3	C04

17.	a.	Explain different types of interaction of radiation with matter.	10 Marks	L3	C05
	b.	Mention the characteristic properties of LASER beam. The ratio of population of two energy levels is 1.059×10^{-30} . Find the wavelength of light emitted at 320K.	10 Marks	L3	C05
Or					
18.	a.	What is the principle behind the propagation of light through an optical fiber? Explain with a neat labeled diagram. Define angle of acceptance and mention the expression to calculate the same. Discuss advantages of optical fiber communication.	10 Marks	L3	C05
	b.	Explain point to point communication system with neat diagram. The refractive indices of core and cladding are 1.50 and 1.48 respectively in an optical fiber 'A' and The refractive indices of core and cladding are 1.48 and 1.46 respectively for an optical fiber 'B'. Find the numerical aperture and angle of acceptance for each optical fiber. Analyze and interpret the results.	10 Marks	L4	C05