Name: Enrolment No:	UPES UNIVERSITY OF TOMORROW

UPES
End Semester Examination, May 2025

Course: Physics for Computer Engineers **Semester : II**
Program: B.Tech. CSE (Batches 33-80) **Time : 03 hrs.**
Course Code: PHYS1036 **Max. Marks: 100**

Instructions:

- **There are 3 Sections such as Section A, B & C**
- **Section A is compulsory, Section B & Section C have internal choices**
- **Scientific calculator is allowed**

SECTION A
Answer All the Questions ($5Q \times 4M = 20$ Marks)

S. No.	Statement of the Question	Marks	CO
Q 1.	Determine the energy and momentum of a photon of laser beam of wavelength 6328 Å.	4	CO1
Q 2.	Write Maxwell's four equations in integral form for time dependent fields.	4	CO3
Q 3.	Explain pair production and pair annihilation.	4	CO4
Q 4.	Using Heisenberg's uncertainty relation, calculate electron's minimum energy if they are confined in a box of size 1 Å.	4	CO4
Q 5.	What do you understand by Fermi energy? Draw the Fermi energy level diagram for n-type semiconductors.	4	CO5

SECTION B
Answer All the Questions (Internal Choice in Q.9) ($4Q \times 10M = 40$ Marks)

Q 6.	Describe the construction and working of Ruby laser with the help of suitable diagrams.	10	CO1
Q 7.	Prove that the work done by an electrostatic field on a moving charge around a closed path is zero and hence derive a relation between the electrostatic field and electric potential.	10	CO2
Q 8.	(a) Explain the following; i. mass action law ii. neutrality of a semiconductor. (b) The electron and hole mobilities in a Silicon sample are 0.155 and 0.058 $m^2/V-s$ respectively. Determine the conductivity of intrinsic Silicon at 300 K if the intrinsic carrier concentration is 1.5×10^{16} atoms/m^3.	10	CO5

Q 9.	Derive an expression for the energy of a particle enclosed within an infinite potential well and hence calculate the ratio of energies of the first two excited energy levels. **OR** Establish the following relation between the recoil angle of an electron (ϕ) and the scattering angle (θ) of a photon in Compton Scattering; $$\phi = tan^{-1}\left(\frac{\cot\frac{\theta}{2}}{1+\frac{h\nu}{m_0 c^2}}\right)$$	**10**	**CO4**
SECTION-C **Answer All the Questions (Internal Choice in Q.11) ($2Q \times 20M = 40$ Marks)**			
Q 10.	(a) Discuss Maxwell's correction in Ampere's law and hence derive Maxwell's fourth equation in its final form. (b) Explain Hall effect with a neat and clean diagram and derive an expression for Hall coefficient.	**10** **10**	**CO3** **CO5**
Q 11.	(a) What do you mean by wave function and what properties should a function possess to be considered as a wave function? Considering the wavefunction as a function of space and time, derive time-dependent Schrodinger wave equation. (b) An electron is trapped in an infinitely deep potential well of width L. If it is in its ground state, what fraction of the time does it spend in the central one-third portion of the well. **OR** (a) What is the phase velocity of a wave and how is it different from group velocity? Show that in the case of matter waves it is the wave group that constitutes the matter waves and derive a relation between phase and group velocities. Also, prove that the group velocity of a matter wave is equal to the velocity of the moving particle. (b) Using Heisenberg's uncertainty relation, show why an electron cannot exist inside the nucleus.	**15** **5** **15** **5**	**CO4**

Standard Physics Constants and their values:

Constants	Standard values
Planck's constant (h)	$6.626 \times 10^{-34}\ Js$
Permittivity of free space (ε_0)	$8.854 \times 10^{-12}\ F/m$
Velocity of light (c)	$3 \times 10^{8}\ m/s$
Boltzmann constant (k_B)	$1.38 \times 10^{-23}\ J/K$
Rest mass of an electron (m_0)	$9.11 \times 10^{-31}\ kg$
Charge on electron (e)	$1.6 \times 10^{-19}\ C$