Name: **Enrolment No:**	UPES UNIVERSITY OF TOMORROW

UPES

End Semester Examination, May 2024

Course: Physics for Computer Engineers — **Semester: II**

Program: BTech SOCS (all batches) — **Time: 03 hours**

Course Code: PHYS 1032 — **Max. Marks: 100**

Instructions:

- All questions are compulsory (**Q. No. 6** and **Q. No. 10** has an internal choice).
- All **highlighted** representations are **vector quantities**.
- Scientific calculators can be used for calculations.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1.	Explain the construction process involved in developing a hologram with a neat diagram.	**4**	**CO1**
Q 2.	Prove that electric field intensity is negative gradient of potential. State the significance of negative sign.	**4**	**CO2**
Q 3.	Write Maxwell's equations in integral forms with their physical significance.	**4**	**CO3**
Q 4.	Write the continuity equation for charge conservation and its form for steady state.	**4**	**CO3**
Q 5.	Explain the de-Broglie hypothesis and write an expression for the wavelength of an electron accelerated with potential V.	**4**	**CO4**
	SECTION B **(4Qx10M= 40 Marks)**		
Q 6.	Discuss the characteristic properties of a LASER beam. Derive the relationship between Einstein coefficients for spontaneous and stimulated emission and explain the outcome. **OR** Explain the propagation mechanism in an optical fiber. The velocity of a signal in the core of the optical fiber is 10^8 m/s and the critical angle is 55°. Determine the numerical aperture of the fiber.	**10**	**CO1**
Q 7.	Determine the divergence and curl of the following vector fields (a) $\boldsymbol{P} = x^2yz\,\boldsymbol{a_x} + xz\,\boldsymbol{a_z}$ (b) $\boldsymbol{Q} = \rho \sin\varphi\,\boldsymbol{a_\rho} + \rho 2z\,\boldsymbol{a_\varphi} + z\cos\varphi\,\boldsymbol{a_z}$.	**10**	**CO2**
Q 8.	Explain the Biot-Savart law and calculate the magnetic field intensity of a straight current-carrying conductor of finite length.	**10**	**CO3**

Q 9.	What do you understand by phase velocity (v_p) and group velocity (v_g) and prove the following $$v_g = v_p - \lambda \frac{dv_p}{d\lambda}$$ Discuss the physical significance of v_g for dispersive and non-dispersive media.	**10**	**CO4**
SECTION-C (2Qx20M=40 Marks)			
Q 10.	**(a)** Explain the physical significance of a wave function. Derive Schrodinger's time-dependent wave equation. **(b)** Normalize the wave function: $\Psi(x) = A\, e^{ikx}$, over the region -a ≤ x≤ a **OR** **(c)** Discuss the Compton Effect with the help of a proper diagram. Show that in Compton Scattering, the wavelength of the scattered photon is given by $\lambda' = \lambda + \frac{h}{m_0 c}(1 - cos\theta)$, where λ is the wavelength of the incident photon, θ and ϕ are the angles of scattered photon and recoiled electron, respectively, and m_0 is the rest mass of an electron. **(d)** By using Heisenberg's uncertainty principle, prove that the electron cannot exist in the nucleus of an atom.	**15 + 5**	**CO4**
Q 11.	**(a)** What do you understand by Fermi energy? Draw the Fermi energy level diagram for p and n-type semiconductors. **(b)** Explain Hall-effect. Derive the expression for the Hall coefficient and carrier concentration in the case of semiconducting materials. **(c)** A Ge p-n junction at 300 K has the following parameters $N_D = 5 \times 10^{18}$ / cm^3, $N_A = 6 \times 10^{16}$ / cm^3, $n_i = 1.5 \times 10^{10}$ / cm^3. Calculate the minority electron concentration in the P–region.	**5 + 10 + 5**	**CO5**

Constant	Standard Values
Planck's Constant (h)	6.63×10^{-34} Joule − sec
Permittivity of free space (ε_0)	8.85×10^{-12} Farad/meter
Velocity of light (c)	3×10^{8} m/sec
Boltzmann constant (k_B)	1.38×10^{-23} JK^{-1}
Rest mass of an Electron (m_o)	9.11×10^{-31} kg
Mass of the proton (m_p)	1.67×10^{-27}kg
Charge of an electron (e)	1.6×10^{-19} C
Del operator in cylindrical coordinate system	$\vec{\nabla} = \frac{\partial}{\partial \rho}\hat{a}_\rho + \frac{1}{\rho}\frac{\partial}{\partial \varphi}\hat{a}_\varphi + \frac{\partial}{\partial z}\hat{a}_z$