Name: **Enrolment No:**	UPES

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, December 2021

Course: Engineering Physics **Semester: I**
Course Code: PHYS 1023 **Max. Marks: 100**
Programme: B.Tech CS (All Branches) **Total pages: 3**
Time: 03 hrs.

Instructions:

- All questions are compulsory (**Q9** and **Q11** have an internal choice)
- Use blank paper as rough work to solve the questions in section-A and write only the correct options (type answers, no upload)
- Scientific calculators can be used for calculations.
- All bold representations are vector quantities.

SECTION-A

S. No.		Marks	CO
Q1.	(a) The refractive index of the core is ----------than that of the cladding. (b) The image that carries all the characteristics of an object is the ---------- (c) The basic principle involved in the transmission of light through an optical fibre is …… (d) A hologram acts like a ……..in the reconstruction process.	**4**	**CO1**
Q2.	Express the point $P\ (-4, 6, 3)$ in cylindrical coordinates	**4**	**CO2**
Q3.	(a) The unit for magnetic flux density is …….. (b) The emf produced in a moving loop in a static magnetic field is …… (c) The net flux through a closed surface in a magnetic field is …….. (d) A magnetostatic field is produced due to a ……	**4**	**CO3**
Q4.	Select all options that satisfy the properties of wave function ψ (a) the wave function must be single-valued (b) the wave function must be discontinuous (c) the wave function must be continuous (d) the wave function must be differentiable (e) the wave function must be infinite (f) the wave function must be finite valued (g) the wave function must be normalizable	**4**	**CO4**

Q5.	A "Qubit" can be implemented by [choose all that apply] (a) Photonisation of photon (b) polarization of photon (c) The energy level of the neutron (d) The Energy level of an atom (e) rotation of an electron (f) spin orientation of an electron	**4**	**CO5**
SECTION-B (Question No: 9 has an internal choice)			
Q6.	What are Einstein's coefficients? Show that the ratio of Einstein's spontaneous coefficient to stimulated coefficient is proportional to the cube of the incident frequency	**10**	**CO1**
Q7.	Using Ampere's law and continuity equation, obtain an expression for the displacement current density.	**10**	**CO3**
Q8.	(a) Write any five differences between quantum computers and classical computers(5) (b) Given $\|\psi\rangle = 4\|0\rangle - 3i\ \|1\rangle$, find its normalized state. (5)	**10**	**CO5**
Q9.	(a) Find the de-Broglie wavelength of a virus particle of mass 1.5×10^{-15} kg moving at a speed of 2×10^{-3} $\mathrm{m/s}$. (answer upto the third decimal) (5) (b) Derive a relation between the phase velocity and group velocity. (5) **OR** (a) Calculate the work function in electron volts of a metal, given that the photoelectric threshold wavelength 6200 Å (5) (b) By applying the uncertainty principle, explain the non-existence of an electron in an atomic nucleus. (5)	**10**	**CO4**
SECTION-C (Question No: 11 has an internal choice)			
Q10.	(a) Apply Coulomb's law to derive an expression for the electric field intensity due to an infinite line charge of linear charge density ρ_l $\mathrm{C/m}$. (10) (b) Derive the boundary conditions for the tangent and normal components of an electric field at the interface of two mediums with different dielectric constants ε_{r_1} andε_{r_2} respectively. Assume that the free surface charge density $\rho_s = 0$ across the boundary. (10)	**20**	**CO2**

Q11.	(a) A metallic surface, when illuminated with light of wavelength λ_1, emits electrons with energies upto a maximum value E_1, and when illuminated with light of wavelength λ_2, where $\lambda_2 < \lambda_1$, it emits electrons with energies upto a maximum value E_2. Prove that Plank's constant h and the work function φ of the metal are given by $h = \frac{(E_2 - E_1)\lambda_1\lambda_2}{C(\lambda_1 - \lambda_2)}$ and $\varphi = \frac{E_2\lambda_2 - E_1\lambda_1}{(\lambda_1 - \lambda_2)}$ (10) (b) Describe the experiment of Davisson and Germer to demonstrate the wave character of electrons. (10) **OR** (a) Show that the wave function of a particle trapped into a one-dimension box of length L is $\Psi_n(x) = \sqrt{\frac{2}{L}}\sin(\frac{n\pi x}{L})$, where n=1, 2, 3,….. (10) (b) (i) Calculate the lowest energy of an electron confined in a 3-D cubical box of each side 1 Å (5) (ii) Find the temperature at which the average energy of the molecules of a perfect gas would be equal to the lowest energy of the electron. (5)	**20**	**CO4**

Values of constants:

Constant	Standard Values
Planck's Constant (h)	6.63×10^{-34} Joule sec
Permittivity of free space (ϵ_0)	8.854×10^{-12} Farad/metre
Velocity of Light (c)	3×10^{8} metre/sec
Boltzmann constant (K_B)	1.38×10^{-23} Joule/Kelvin
Rest mass of an Electron (m_0)	9.11×10^{-31} Kg
Charge of an electron (q)	1.6×10^{-19} C
Mass of a Proton (m_p)	1.67×10^{-27}Kg