Name: Enrolment No:	

UNIVERSITY OF PETROLEUM AND ENERGY STUDIES
End Semester Examination, May 2023

Course: Engineering Physics — **Semester: II**
Program: B.Tech. CS (Batches: 21-46) — **Time: 03 hrs.**
Course Code: PHYS 1023 — **Max. Marks: 100**

Instructions:

- **There are 3 Sections, such as section A, B & C.**
- **Section A is compulsory; however, section B & section C have internal choices.**
- **A scientific calculator is allowed.**

SECTION A
($5Q \times 4M = 20\ Marks$)

S. No.		Marks	CO
Q 1.	With a suitable diagram, explain the recording of a hologram.	**4**	**CO1**
Q 2.	Check whether the electrostatic field represented by $\vec{E} = axy^2(y\,\hat{\imath} + x\hat{\jmath})$ is conservative or not?	**4**	**CO2**
Q 3.	Write Maxwell's equations in differential form for time-varying fields.	**4**	**CO3**
Q 4.	Calculate the ratio of de-Broglie waves associated with a proton and an electron, each having kinetic energy of 20 MeV.	**4**	**CO4**
Q 5.	List out the applications of nanomaterials.	**4**	**CO5**

SECTION B
($4Q \times 10M = 40\ Marks$)

Q 6.	Explain the construction and working of a He-Ne laser using suitable diagrams. Differentiate between He-Ne laser and Ruby laser.	**10**	**CO1**
Q 7.	Explain the concept of Maxwell's displacement current and show how it led to the modification of Ampere's law.	**10**	**CO2**
Q 8.	(a) In a certain region, $\vec{J} = 3r^2 \cos\theta\ \hat{a}_r - r^2 \sin\theta \hat{a}_\theta$ A/m, find the current crossing the surface defined by $\theta = 30°$, $0 < \phi < 2\pi$, $0 < r < 2$ m. (b) What are nanomaterials? Differentiate between classical and quantum computing.	**5** **5**	**CO3** **CO5**

Q 9.	Calculate the work function, stopping potential and maximum velocity of photoelectrons for a light of wavelength 4350 Å when it incident on sodium surface. Consider the threshold wavelength of photoelectrons to be 5420 Å. **OR** Show that when a photon of energy E is scattered from a free electron at rest (rest mass energy $\boldsymbol{E_0}$), the maximum kinetic energy of the recoiling electron is given by $K.E. = \frac{2E^2/E_0}{1 + 2E/E_0}$	**10**	**CO4**
	SECTION-C **$(2Q \times 20M = 40\ Marks)$**		
Q 10.	(a) Explain the attenuation in optical fiber. What are the important factors responsible for the loss in optical fiber? Discuss.	**10**	**CO1**
	(b) Show that the pair producton phenomenon cannot occur in empty space.	**10**	**CO4**
Q 11.	(a) Show if a particle of mass m is confined a one-dimensional box of length a, the allowed energies and normalized wave functions are $E = \frac{n^2h^2}{8ma^2}$ and $\psi = \sqrt{\frac{2}{a}} sin\left(\frac{n\pi x}{a}\right)$	**15**	**CO4**
	(b) A magnetic field $\vec{B} = B_0(\hat{\imath} + 2\hat{\jmath} - 4\hat{k})$ exists at a point. If a test charge moves with a velocity $\vec{v} = v_0(3\,\hat{\imath} - \hat{\jmath} + 2\hat{k})$ experiences no force at a certain point, what will be the electric field at that point in SI units? OR	**5**	**CO3**
	(a) What is the significance of wave function ψ? Deduce the time-dependent Schrodinger wave equation.	**15**	**CO4**
	(b) Using Ampere's law, obtain an expression for the magnetic field due to a current carrying a straight conductor of infinite length.	**5**	**CO3**

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)	$1.6 \times 10^{-19}\ C$