Name: **Enrolment No:**	

UPES

End Semester Examination, December 2023

Course: Physics **Semester: I**

Program: SOAE (All Branches) **Time : 03 hrs.**

Course Code: PHYS 1002 **Max. Marks: 100**

Instructions: Use of scientific calculator is allowed.

SECTION A
(5Qx4M=20Marks)

S. No.		Marks	CO
Q 1	The numerical aperture of a fiber is 0.25 and relative refractive index is 0.02. Determine the refractive indices of the core and cladding of a fiber.	**4**	**CO1**
Q 2	Prove that why a matter wave cannot move with the phase velocity.	**4**	**CO3**
Q 3	The magnetic susceptibility of aluminium is 2.3×0^{-5}. Find its permeabilty and relative permeabilty.	**4**	**CO2**
Q 4	Point charges 1 mC and - 2 mC are located at (3, 2, -1) and (-1, -1,4), respectively. Calculate the electric force on a 10nC charge located at (0, 3, 1) and the electric field intensity at that point.	**4**	**CO2**
Q 5	Calculate the smallest possible uncertainty in the position of an electron moving with velocity of $3x10^7$ m/s.	**4**	**CO3**
	SECTION B (4Qx10M= 40 Marks)		
Q 6	Using Maxwell's equations, formulate the electromagnetic wave propagation in free space. How would you define impedance of the electromagnetic wave? Find an expression for it.	**10**	**CO2**
Q 7	Using the definitions of Einstein coefficients A and B, derive an expression for the net rate of change of population in a two-level system undergoing absorption, spontaneous emission, and stimulated emission processes. **OR** Draw a flowchart for analysis of polarized light by using nicol prism and quarter wave plate.	**10**	**CO1**
Q 8	Explain why ferromagnetic materials do not completely lose their magnetism when magnetic field is applied and then removed.	**10**	**CO2**
Q 9	Define Bravais lattice and describe their different types.	**10**	**CO4**

SECTION-C (2Qx20M=40 Marks)			
Q 10	(**a**) In the quest of harvesting clean energy via various non-conventional sources, solar photovoltaics seem to gain most of the attention due to being economical and technologically feasible. In the scheme of solar photovoltaics, a solar cell is the most fundamental building block. With respect to a solar cell, explain following parameters: 1. Fill factor 2. Maximum power point 3. Efficiency of a solar cell. 4. Open circuit voltage 5. Short Circuit Current **(10)** (**b**)1. In a simple cubic crystal, find the ratio of spacings of (1 1 0) and (1 1 1) planes. 2. The spacing of (100) planes in an NaCl crystal is 2.820 Å. The X-rays incident on the surface of this crystal is found to give rise to first order reflection at a grazing angle of 15.8°. Calculate the wavelength of the X-rays used. **(5+5)**	**20**	**CO4**
Q 11	(**a**) Quantum mechanics is all about uncertainties and probabilities. Briefly explain the principle which describes uncertainties in measurements at minuscular scale. Furthermore, using this principle prove that it is impossible for an electron to reside inside the nucleus. (**10**) (**b**) The idea to harvest solar energy via solar cells could not have been materialized if we would not have understood photoelectric effect. But our current understanding of photoelectric effect was not possible without seminal contributions from Albert Einstein (Nobel prize 1923) on this topic. With the help of graphs, discuss the outcome of various experiments which led Einstein to promulgate the theory of photoelectric effect in a form which we know it today. (**10**) **OR** (**a**) Pair production was the first experimental evidence of conversion of energy into mass. Using this information, explain the phenomenon of pair production and explain as to why it cannot take place in empty space. **(10).**	**20**	**CO3**

	(**b**) State the physical significance of a wave function. Furthermore, derive the Schrodinger's time-independent wave equation. **(10)**		

Constant	Standard Values
Planck's Constant (h)	6.63×10^{-34} Joule-sec
Rest mass of an Electron	9.11×10^{-31} Kg
Permittivity of free space (ε_o)	8.854×10^{-12} Farad/meter
Velocity of Light c	3×10^{8} m/sec
Charge of electron	1.6×10^{-19}C