BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION SP/2023)

CLASS: IMSc   SEMESTER : IV
BRANCH: PHYSICS   SESSION : SP/2023

SUBJECT: PH208 ELEMENTS OF MODERN PHYSICS
TIME: 02 Hours   FULL MARKS: 25

INSTRUCTIONS:
1. The question paper contains 5 questions each of 5 marks and total 25 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. **Tables/Data handbook/Graph paper etc., if applicable, will be supplied to the candidates**

			CO	BL
Q.1(a)	How Einstein's hypothesis of light quanta differs from Planck's hypothesis?	[2]	1	I
Q.1(b)	In Compton effect, show that the fractional change in energy of the photon is equal to $h\nu'(1-\cos \phi)/m_o c^2$, where ν' is the frequency of scattered photon and ϕ is the angle of scattering.	[3]	1	II
Q.2(a)	Find the de Broglie wavelength of an electron moving with velocity, $v = 3c/5$.	[2]	1	I
Q.2(b)	State and prove Heisenberg's uncertainty relation in estimating the position and momentum of a quantum mechanical particle.	[3]	1	V
Q.3(a)	Define the concept of probability current density.	[2]	2	I
Q.3(b)	Using a classical wave equation, derive the time-independent and time dependent Schrodinger equation for a moving particle.	[3]	2	V
Q.4(a)	Define Normalization and orthogonalization of a wavefunction.	[2]	2	I
Q.4(b)	The normalized state of a free particle is represented by the wave function, $\psi(x,0) = N \exp[(-x^2/2\alpha^2)+ikx]$ (i) Find the factor N. (ii) In what region of space, the particle is most likely to be found.	[3]	2	I
Q.5(a)	What do you mean by tunneling through a barrier?	[2]	3	I
Q.5(b)	Find the energy and momentum eigen values of a particle confined in a one dimensional infinitely rigid potential box of width L.	[3]	3	I

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