BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(END SEMESTER EXAMINATION)

SEMESTER : I
SESSION : MO/2023

CLASS: BTECH/IMSC
BRANCH: BT/CIVIL/CHEMICAL/MECH/PIR/FT/PHYSICS
SUBJECT: PH113 PHYSICS

FULL MARKS: 50

TIME: 3 Hours

INSTRUCTIONS:
1. The question paper contains 5 questions each of 10 marks and total 50 marks.
2. Attempt all questions.
3. The missing data, if any, may be assumed suitably.
4. Before attempting the question paper, be sure that you have got the correct question paper.
5. Tables/Data handbook/Graph paper etc. to be supplied to the candidates in the examination hall.

			CO	BL
Q.1(a)	Define polarization of light. Discuss the polarization by reflection and prove the Brewster law. Now, consider a polarizer with a refractive index of 1.45. Calculate the polarization angle and the corresponding angle of refraction?	[5]	1	1,2,3
Q.1(b)	In a Newton's ring arrangement with a film observed with light of wavelength 6 x 10^{-5} cm, the difference in the square of the diameters of successive rings is $\Delta D = 0.125$ cm^2. How will ΔD change if: i) Wavelength of light is changed to 4.5 x 10^{-5} cm. ii) The radius of curvature of convex surface of plano-convex lens is doubled.	[5]	1	1,2,3
Q.2(a)	Show that curl of a gradient is always zero.	[2]	2	1
Q.2(b)	Using Gauss's law, find the electric field due to an infinite charge sheet with (surface) charge density σ.	[3]	2	1,2,3
Q.2(c)	What is displacement current? Discuss the significance of displacement current in Maxwell's equation.	[5]	2	1,2,4
Q.3(a)	The average lifetime of a π-meson in its own frame of reference is 26.0 ns. If the π-meson moves with speed 0.95c with respect to the Earth, what is its lifetime as measured by an observer at rest on Earth? What is the average distance it travels before decaying as measured by an observer at rest on Earth?	[4]	3	1,2,3,5
Q.3(b)	Derive Einstein's energy mass relation $E=mc^2$.	[6]	3	1,2
Q.4(a)	Write down the time-independent Schrödinger equation for a particle in a one-dimensional box and obtain the expression for energy levels. Now, consider a neutron confined to such a box 10^{-14} m wide and obtain the ground state (lowest) energy for the neutron in MeV. Mass of a neutron is 1.67 x 10^{-27} kg.	[5]	4	1,2,3,5
Q.4(b)	Considering the Compton scattering set-up, obtain the expression for change in wavelength of an X-ray photon when scattered through a target composed of electrons.	[5]	4	1,2
Q.5(a)	Briefly discuss the basic working principle of a laser. Find the ratio of population of two states in a He-Ne laser that produces a light of wavelength 6328 Å at 27 °C.	[6]	5	1,2,4
Q.5(b)	What are magic numbers for nucleons? Based on the magic numbers, classify the following nuclei as non-magic, singly-magic, and doubly-magic: $_8O^{16}$, and $_{50}Sn^{89}$. Explain your answer.	[4]	5	1,2,3,4,5

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