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

CLASS: BTECH / IMSC **SEMESTER: I**
BRANCH: BT/CE/CHEMICAL/ME/PIE/FT/PHYSICS **SESSION: MO/2025**

SUBJECT: PH24101 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)	Define Brewster's law. Light travelling in water (n_1 = 1.33) is incident on a glass plate of (n_2 = 1.53). At what angle of incidence (in degrees), is the reflected light completely linearly polarized ?	[2]	1	1,3
Q.1(b)	Prove that at angle of incidence equal to Brewster's angle, the reflected and refracted rays are perpendicular to each other.	[3]	1	2
Q.2(a)	Explain the phenomenon of interference in thin film of uniform thickness and obtain the conditions of constructive and destructive interference.	[2]	1	1,2
Q.2(b)	A plane wave ($\lambda = \mathbf{500\,nm}$) falls normally on a long narrow slit of width 0.5 mm. Calculate the angles of diffraction (in degrees) corresponding to the first and second minimum. How will the angles change if the slit width is reduced to 0.1 mm ?	[3]	1	3
Q.3(a)	Define Gauss law of electrostatics. If the di-electric displacement vector (in vacuum) is given by $\vec{D} = (2y^2 + z)\hat{\imath} + (4xy)\hat{\jmath} + (x)\hat{k}$, find the volume charge density at the point (-1,0,3) in Coulomb/m^3.	[2]	2	1,3
Q.3(b)	Use Gauss law to find the electric field vector ($\vec{E}$) inside and outside a uniformly charged sphere of radius R. Given the volume charge density of the sphere is ρ_0 Coulomb/m^3.	[3]	2	3
Q.4(a)	Define dielectric polarization ($\vec{P}$). How is it related to the electric field ($\vec{E}$) for a linear, homogeneous, isotropic di-electric ?	[2]	2	1,2
Q.4(b)	A sphere of radius R carries a polarization $\vec{P} = k\vec{r}$ where k is a constant and $\vec{r}$ is the radial vector from its center. Calculate: (i) The bound surface (σ_b) and volume (ρ_b) charge densities. (ii) The Electric field ($\vec{E}$) inside and outside the sphere	[3]	2	2,3
Q.5(a)	Define an inertial frame of reference. What are the postulates of Special theory of relativity	[2]	3	1
Q.5(b)	Derive the Lorentz transformations connecting two inertial frames moving with a velocity v with respect to each other	[3]	3	3

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