BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION SP2023)

CLASS: IMSC **SEMESTER : VI**
BRANCH: PHYSICS **SESSION : SP2023**

SUBJECT: PH315 ELECTROMAGNETIC THEORY

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)	Fill in the blank and write the mathematical expression of it: The net outward flow of flux of a vector field per unit volume over a closed incremental surface_____ The circulation of a vector field per unit surface area_____	[2]	1	2
Q.1(b)	For any vector field $\vec{A}$, write the value of the divergence of the curl of the vector field. Under some circumstances, if curl of a vector field $\vec{A}$ is zero, what would be the mathematical expression of vector field $\vec{A}$? Suppose $\vec{A}$ is magnetic vector potential, what does the curl of magnetic vector potential corresponds to?	[3]	1	2
Q.2(a)	Derive Maxwell's divergence equations for electrostatic and electromagnetic time invariant cases.	[2]	1	3
Q.2(b)	Derive Maxwell's curl equations for electrostatic and electromagnetic time invariant cases. Derive Maxwell's third equation for electrodynamic case.	[3]	1	3
Q.3(a)	The divergence of Maxwell's fourth equation for electromagnetic time invariant case contradicted continuity equation. Derive Maxwell's fourth equation for electrodynamic case.	[2]	2	4
Q.3(b)	Derive continuity equation. Explain relaxation time and derive mathematical expression of it in terms of permittivity and conductivity of the medium.	[3]	2	4
Q.4(a)	Write the mathematical expressions for electric field vector and Lorenz condition for potentials for electrodynamic case.	[2]	2	4
Q.4(b)	Derive Poisson's equations for electrodynamic cases for electric scalar potential (Φ) and magnetic vector potential $(\vec{A})$.	[3]	2	4
Q.5(a)	Write the point form of Maxwell's equations assuming time factor $e^{-i\omega t}$	[2]	3	5
Q.5(b)	If $\vec{P} = 2sin(10t + x - \pi/4)\hat{y}$ and $\vec{Q}_s = e^{ix}(\hat{x} - \hat{z})sin(\pi y)$, determine the phasor form of $\vec{P}$ and the instantaneous form of $\vec{Q}_s$.	[3]	3	5

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