BIRLA INSTITUTE OF TECHNOLOGY, MESRA, RANCHI
(MID SEMESTER EXAMINATION SP/2024)

CLASS: BTECH **SEMESTER : IV**
BRANCH: ECE **SESSION : SP/2024**

SUBJECT: EC257 ELECTROMAGNETIC FIELD AND WAVES

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)	State the fundamental postulate for electromagnetic induction – a major advance in electromagnetic theory.	[2]	CO1	2
Q.1(b)	A circular loop of N turns of conducting wire lies in the *xy*-plane with its center at the origin of a magnetic field specified by $\mathbf{B} = \mathbf{a}_z B_0 \cos(\pi r/2b).\sin\omega t$, where *b* is the radius of the loop and ω is the angular frequency. Find the emf induced in the loop.	[3]	CO4	5
Q.2(a)	Write the Time-Harmonic Maxwell's equations (both differential and integral form) assuming time factor $\mathbf{e}^{j\omega t}$.	[2]	CO2	2
Q.2(b)	An a-c voltage source of amplitude V_0 and angular frequency ω, $v_c = v_0 \sin\omega t$ is connected across a parallel plate capacitor C_1. (a) Verify the displacement current in the capacitor is the same as the conduction current in the wires. (b) Determine the magnetic field intensity at a distance *r* from the wire.	[3]	CO4	5
Q.3(a)	State electromagnetic boundary conditions between (a) two lossless linear media and (b) dielectric medium and a perfect conductor.	[2]	CO1	3
Q.3(b)	What is Lorentz's gauze for potentials. Formulate wave equations for time harmonic potentials, starting from equation for the potentials under static condition.	[3]	CO3	4
Q.4(a)	A uniform plane wave propagting in a medium has $\boldsymbol{E} = 2e^{-\alpha z}\sin(10^8 t-\beta z)\boldsymbol{a}_y$ V/m. If the medium is characterized by ε_r=1, μ_r=20 and σ=3 S/m, find $\boldsymbol{H}$.	[2]	CO3	3
Q.4(b)	Find the Poynting vector on the surface of a long, straight conducting wire (of radius b and conductivity σ) that carries a direct current I. Verify the Poynting theorem.	[3]	CO4	4
Q.5(a)	Prove that a linearly polarized plane wave can be resolved into a right-hand circularly polarized wave and a left-hand circularly polarized wave of equal magnitude.	[2]	CO4	4
Q.5(b)	For a uniform plane wave incident normally at the interface between dielectric and conductor media, establish the mathematical expression of reflection coefficient and transmission coefficient in term of intrinsic impedances.	[3]	CO3	3

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