PAPER ID-421811

Subject Code: REC402

Roll No: | | | | | | | | | | | | | |

BTECH
(SEM IV) THEORY EXAMINATION 2021-22
ELECTROMAGNETIC FIELD THEORY

Time: 3 Hours ***Total Marks: 70***

Note: 1. Attempt all Sections. If require any missing data; then choose suitably.

SECTION A

1. Attempt *all* questions in brief. 2 x 7 = 14

a.	Find the Laplacian of $V_2 = \rho z\,(\cos\phi + \sin\phi)$.
b.	List the examples of uniform and non-uniform electric field.
c.	Examine magnetic scalar and vector potentials.
d.	Charge $10^{-4}e^{-2t}$ C is removed from a sphere through a wire. Find the current in the wire at t=2sec.
e.	Examine mathematically and theoretically $\nabla . \bar{B} = 0$
f.	Examine skin depth for conductors and derive its mathematical expression.
g.	Differentiate magnetic field intensity and electric field intensity.

SECTION B

2. Attempt any *three* of the following: 7 x 3 = 21

a.	Obtain an expression for the electric field for each possible case due to an uniformly charged sphere of radius R and volume charge density ρ.
b.	Derive the mathematical expression for energy stored in magnetic field.
c.	Explain uniform plane wave. Derive uniform plane waves in lossless dielectrics.
d.	Investigate convection and conduction currents. Derive mathematical equations also.
e.	Explain Biot-Savart's law with their mathematical relations.

SECTION C

3. Attempt any *one* part of the following: 7 x 1 = 7

(a)	If $V = x^2 + y^2 + xy$ V, Evaluate **E** at (1, 2, 3) and the electrostatic energy stored in a cube of side 2m centered at origin.
(b)	State and prove Gauss Divergence theorem.

4. Attempt any *one* part of the following: 7 x 1 = 7

(a)	Given that $\vec{A} = \left(\frac{5r^2}{4}\right)\hat{a}_r$ is in spherical coordinates. Find the curl of this vector and its magnitude at (2m, 45°, 90°).
(b)	Derive the Poisson's and Laplace equation in all coordinate systems.

5. Attempt any *one* part of the following: 7 x 1 = 7

(a)	Explain Ampere's circuit law with their mathematical relations.
(b)	Derive the modified Maxwell equations for ampere's circuital law and faradays law.

6. Attempt any *one* part of the following: 7 x 1 = 7

(a)	In free space, $\mathbf{E} = 20\cos(\omega t - 50x)\,\mathbf{a}_y$ V/m. Calculate- **i.** J_d **ii.** H **iii.** w
(b)	Explain transformer and motional electromotive forces with necessary mathematical expressions.

7. Attempt any *one* part of the following: 7 x 1 = 7

(a)	At 50MHz a lossy medium has $\mu = 5\mu_0$, $\varepsilon = 3\varepsilon_0$ and σ=.08 S/m. If $\mathbf{E}_s = 6e^{-\gamma z}\mathbf{a}_x$ V/m find: (i) loss tangent (ii) λ (iii) η.
(b)	Derive the telegraphic equations of the transmission line with neat conductor line diagram.