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BIEE-005

B.Tech. – VIEP – ELECTRICAL ENGINEERING (BTELVI)

Term-End Examination

00042

December, 2017

BIEE-005 : ELECTROMAGNETIC THEORY

Time : 3 hours *Maximum Marks : 70*

Note : *Attempt any* ***five*** *questions. All questions carry equal marks. Use of scientific calculator is allowed.*

1. (a) Given the potential $\bar{V} = \frac{10}{r^2} \sin\theta \cos\phi$,

(i) find the electric flux density 'D' at $(2, \frac{\pi}{2}, 0)$.

(ii) calculate the work done in moving a 10 nC charge from point A(1, 30°, 120°) to B(4, 90°, 60°). 7

(b) State and explain the Gauss Divergence Theorem. Also mention its limitations and utilities. 7

2. (a) Let $D = 2xy\hat{a}_x + x^2\hat{a}_y$ C/m^2, find the following : 7

(i) The volume charge density (ρ_V)

(ii) The flux through surface

$$0 < x < 1,\ 0 < z < 1,\ y = 1.$$

(b) State and prove Stokes' Theorem. What are the limitations and utilities of this theorem ? 7

3. (a) Write short notes on the following : 7

(i) Rectangular Coordinate System

(ii) Spherical Coordinate System

(b) What are the methods of Image ? Also mention its limitations. 7

4. (a) Write short notes on the following : 7

(i) Maxwell's Equations

(ii) Energy Stored in Magnetic Fields

(b) Given that $\bar{J} = 10^4(x^2 + y^2)\ \hat{a}_z\ A/m^2$, determine the following : 7

(i) The current density at (– 3, 4, 6).

(ii) The rate of increase in the volume charge density at (1, – 2, 3).

(iii) The current crossing at disk of radius 5 mm placed on the xy-plane and centered at the origin.

5. (a) For a current distribution in free space,

$$\bar{A} = (2x^2y + yz)\hat{a}_x + (xy^2 - xz^3)\hat{a}_y - (6xyz - 2x^2y^2)\hat{a}_z \text{ Wb/m}$$

(i) calculate $\bar{B}$.

(ii) show that

$$\nabla \cdot A = 0 \text{ and } \nabla \cdot B = 0.$$ *7*

(b) State and explain the Continuity Equation. What are the applications and limitations of this equation ? *7*

6. (a) A plane wave in a non-magnetic medium has $\bar{E} = 50 \sin (10^8 t + 2z)\hat{a}_y$ V/m. Find *7*

(i) the direction of wave propagation

(ii) λ, f and ε_r

(iii) $\bar{H}$

(b) A uniform plane wave in air with

$$\bar{E} = 8 \cos (\omega t - 4x - 3z)\hat{a}_y \text{ V/m}$$

is incident on a dielectric slab ($Z \geq 0$), with $\mu_r = 1{\cdot}0$, $\varepsilon_r = 2{\cdot}5$, $\sigma = 0$. Find the *7*

(i) Polarization of the wave

(ii) Angle of incidence

(iii) Reflected $\bar{E}$ field

(iv) Transmitted $\bar{H}$ field

7. (a) Explain the following : 7

(i) Snell's Law of Refraction

(ii) Poynting Vector and its Applications

(b) A telephone line has R = 30 Ω/km, L = 100 mH/km, G = 0 and C = 20 μF/km. At f = 1 kHz, find 7

(i) the characteristic impedance of the line

(ii) the propagation constant

(iii) the group and phase velocity