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Code No. : 22302

VASAVI COLLEGE OF ENGINEERING (Autonomous), HYDERABAD
B.E. II Year (E.C.E.) II - Semester (Main) Examinations, May - 2016

Electromagnetic Theory

Time: 3 hours

Max. Marks: 70

Note: Answer ALL questions in Part-A and any FIVE from Part-B

Part-A (10 X 2=20 Marks)

1. A field is given as $G = \frac{25}{x^2+y^2} (x \hat{a}_x + y \hat{a}_y)$. Find the angle between G and \hat{a}_x at P (3,4,-2) m.
2. The finite sheet $0 \leq x \leq 1$, $0 \leq y \leq 1$ on the $z = 0$ plane has a charge density $\rho_s = xy(x^2 + y^2 + 25)^{3/2} \eta C/m^2$. Find the total charge on the sheet.
3. State uniqueness theorem.
4. Find the dielectric constant of a material which contains 10^{21} molecules/m³, each of which has a moment of 2×10^{-27} C-m parallel to an electric field of 10^5 V/m.
5. State Biot-Savart's law.
6. Express the magnetic vector potential directly in terms of source current.
7. What is loss tangent? Discuss its significance.
8. What is a uniform plane wave?
9. Give the reason why Brewster angle is not practically possible.
10. State Poynting's theorem.

Part-B (5 X 10=50 Marks)

11. a) Obtain the expression for the electric field due to an infinite line charge located along z-axis. [5]
b) Given $\vec{V} = x \cos^2 y \hat{a}_x + x^2 e^z \hat{a}_y + z \sin^2 y \hat{a}_z$ and 'S' is the surface of a unit cube with one corner at the origin and edges parallel to the coordinate axis. Find the value of the integral $\iint_S \nabla \cdot \hat{n} dS$ [5]
12. a) Derive divergence of current density in electrostatic field. [5]
b) Two media 1 and 2 are separated by X-Y plane. Medium 1 ($z > 0$, $\epsilon_{r1} = 4$) has electric field $3\hat{a}_x + 5\hat{a}_y + 2\hat{a}_z$ V/m. What will be the electric field and electric flux density in medium 2 ($z < 0$, $\epsilon_{r2} = 16$). [5]
13. a) Derive an expression for inductance of N-turn solenoidal coil. [5]
b) A current sheet $K = 8 \hat{a}_x$ A/m flows in the region $-2 < y < 2$ in the plane $z = 0$. Calculate H, at P(0,0,3) m. [5]
14. a) Show that the ratio of E and H in free space is 120π Ohms. [4]
b) For uniform plane wave in sea water $\sigma = 4$ mho/m, $\epsilon = 80\epsilon_0$, $\mu = \mu_0$. Find attenuation constant, phase shift constant, propagation constant, velocity of wave, wave length and intrinsic impedance for the following two frequencies 10 GHz and 25 GHz. [6]
15. a) Determine the resultant electric and magnetic fields of a plane wave, when it is incident on a perfect conductor normally. [6]

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- b) A uniform plane wave in air impinges at 45° angle on a lossless dielectric material with dielectric constant ϵ_r . The transmitted wave propagates in a 30° direction with respect to the normal. Find ϵ_r . [4]
16. a) Given that $\vec{D} = r^2 \hat{a}_r + 2 \sin \theta \hat{a}_\theta$ in spherical coordinate system, where D is the electric flux density. Find the charge density ρ_v . [5]
- b) The point charges -1 nC , 4 nC and 3 nC are located at $(0,0,0) \text{ m}$, $(0,0,1) \text{ m}$ and $(1,0,0) \text{ m}$ respectively. Find the energy stored in the system. [5]
17. Write short notes on any two of the following:
- a) Stoke's theorem [5]
- b) EM Wave Polarization [5]
- c) Instantaneous, average and complex Poynting's vector. [5]
