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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belgaum)

Fourth Semester, B.E. - Electronics and Communication Engineering

Semester End Examination; June/July - 2015

Electromagnetic and Antennas

Time: 3 hrs *Max. Marks: 100*

***Note** : Answer **FIVE** full questions, selecting **ONE** full question from each **Unit**.*

UNIT - I

1. a. State Coulomb's law. Also write its vector form. 6

   b. An electron beam with volume charge density $\rho_v = -5\times10^{-6} e^{-10^5 \rho z} C/m^3$ is oriented along Z-direction. Calculate the total charge enclosed by the beam if 0.02 m < Z < 0.04 m, $0 < \phi < 2\pi$ and $0 < \rho < 0.01$m 8

   c. Develop an equation for Electric field intensity due to a sheet of charge along YZ plane at a point on positive X axis. 6

2. a. Explain the following terms : 10
   (i) Electric Flux density (ii) Divergence

   b. A 50 cm long co-axial cable has an inner radius 1 mm and outer radius of 4 mm. Space between the conductors is filled with air dielectric. Total charge on inner conductor is 30 nC calculate; ρ_s (inner) D_ρ and E_ρ 6

   c. If $D = e^{-x} \sin y\, \hat{a}_x - e^{-x} \cos y\, \hat{a}_y + 2z\, \hat{a}_z \;\; C/m^2$. Calculate divergence of D. What is its unit? 4

UNIT – II

3. a. Non uniform field E is given by $E = y\, \hat{a}_x + x\, \hat{a}_y + 2\, \hat{a}_z \; V/m$. Calculate the work expended in carrying 2 C from B (1, 0, 1) to A (0.8, 0.6, 1) along the shorter arc of the circle $x^2 + y^2 = 1$, $z = 1$. 8

   b. Develop the relationship between E and V. What is gradient of V in the three co-ordinate systems? 8

   c. Define a dipole? Develop the equation for V at point P located at R_1 and R_2 respectively with respect to the charges. 4

4. a. Develop Poisson's and Laplace's equation from Guass Law. Write Laplacian of V in 3 coordinate systems. 8

   b. State and prove uniqueness theorem. 6

   c. Explain the concept of Scalar and Vector magnetic Potential. 6

Contd…2

UNIT – III

5. a. A current element 4cm long is along y axis with a current of 10 mA flowing in y direction. Calculate the force on the current element due to magnetic field $H = [5\,\hat{a}_x / \mu]\, A/m$ — 4

   b. Explain the nature of ferromagnetic, anti ferromagnetic, ferromagnetic and super paramagnetic materials. — 8

   c. If $\mu = \mu_1 = 4$ μH/m region 1 of where $z > 0$, while $\mu_2 = 7$ μH/m wherever $z < 0$ and $k = 80\,\hat{a}x$ A/m on the surface $z = 0$. If $B_1 = 2\hat{a}_x - 3\hat{a}_y + \hat{a}_z\ mT$ in region 1, calculate B_2. — 8

6. a. Starting from Faraday's Law, show that for a time varying fields $\nabla \times E = -\frac{\partial B}{\partial t}$. — 8

   b. Assuming that time changing magnetic field produces an electric field, develop Ampere's circuital Law in point form. — 8

   c. Write Maxwell's with equation in integral form for time varying fields. — 4

UNIT - IV

7. a. Explain the terms poynting vector, skin effect and wave polarization with respect to uniform plane waves. — 10

   b. Define the terms: (i) SWR (ii) Reflection coefficient. What is the relationship between them? — 5

   c. Explain wave propagation in general dielectrics — 5

8. a. Define terms with respect to antenna:
   (i) antenna patterns (ii) beam solid angle (iii) Directivity — 9

   b. Explain: (i) Antenna field zones (ii) shape- Impedance consideration — 6

   c. Develop the relationship between directivity and effective aperture of an antenna in terms of λ. — 5

UNIT - V

9. a. With respect to radiation explain the terms:
   (i) Electrostatic field
   (ii) Induction field
   (iii) Hertzian dipole — 8

   b. Calculate the distance beyond which the earth's curvature in to be accounted at:
   (i) 100 kHz (ii) 1 MHz (iii) 10 MHz What is the inference? — 6

   c. Briefly explain super refraction. — 6

10 a. Explain tropospheric propagation in the detail. — 8

   b. Explain the terms:
   (i) Critical frequency (ii) MUF (iii) Virtual height — 6

   c. Calculate the skip distance for flat earth with MUF of 10 MHz if the wave is reflected from a height of 300 km where maximum value of n is 0.9. — 6

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