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

(An Autonomous Institution affiliated to VTU, Belagavi)

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

Semester End Examination; May/June - 2018

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. Develop an equation for Electric field intensity due to an infinite sheet of charge lying along *yz* plane at a point on positive *X*-axis. 7

b. State and explain Coulomb's law. Also write its vector form. 6

c. A uniform line charge $\rho_l = 25\, nC/m$ lies on the line x = -3 m, Z = 4 m, in free space. Find the electric field intensity at a point (2, 15, 3) m. 7

2 a. State and prove Gauss divergence theorem. 5

b. Find the total charge inside a cubical volume 2 m of one side situated with 3 edges coincident with *x, y, z* axis is given by $\vec{D} = xyz\,\hat{a}_x + x^2y^2z^2\,\hat{a}_y + x^3y^3z^3\,\hat{a}_z.\ {}^{C}/_{m^2}$ 7

c. Given that the field $\vec{D} = \dfrac{5\sin\theta\cos\phi}{r}\,\hat{a}_r.\ {}^{C}/_{m^2}.$

Calculate; 8

(i) Volume change density

(ii) The total electric flux leaving the surface of the spherical volume of radius 2 mt.

UNIT - II

3 a. Develop the relationship between E and V. Explain the conservative nature of static electric field. 6

b. Derive equation for potential at a point on the axis of circular line of charge. 6

c. If three charges 3 µc, -4 µc, 5 µc are located at (0, 0, 0), (2, -1, 3) and (0, 4, -2) respectively. Calculate the potential at (1, 0, 1) assuming zero potential at infinity. 8

4 a. Starting from Gauss law in point form, derive Laplace and Poisson's equation. Show that the potential field $V = 2x^2-3y^2+z^2$ satisfies Laplace's equation. 8

b. By using Biot-savart's law derive equation for magnetic field Intensity at a point along *y*-axis due to an infinitely long straight current carrying conductor along Z-direction. 8

c. Write note on magnetic vector potential. 4

UNIT - III

5 a. Derive an expression for magnetic torque and magnetic dipole moment for a rectangular planar coil carrying current *I* placed in *XY* plane and parallel to the magnetic field. 6

Contd…2

b. In region 1 at $Z < 0$ has $\mu_{r1} = 1.5$, region 2 at $Z > 0$ has $\mu_{r2} = 1$. The flux density $\vec{B} = 1.2\,\hat{a}_x + 0.8\,\hat{a}_y + 0.4\,\hat{a}_z$. Tesla is incident at boundary from region 1. Calculate $\vec{B}_2$. 8

c. Derive the equation for self inductance of co-axial cable. 6

6 a. List Maxwell's equation both in integral form and point form. 8

b. Explain the concept of displacement current density. A lossy dielectric has $\mu = 4\pi \times 10^{-9}\ {}^{H}/_{m}$ and $\in = \frac{10^{-8}}{36\pi}\ {}^{F}/_{m}$, $\sigma = 2 \times 10^{-8}\ \text{℧}/m$, at what frequency will the conduction current density and displacement current densities have equal magnitude. 7

c. Write note on retarded potentials. 5

UNIT - IV

7 a. Discuss the wave propagation in dielectric with related equations. 8

b. An interface is formed by two dielectrics with η_1 = 100 Ω, η_2 = 300 Ω, E_i = 100 V/m. Calculate: (i) Reflection coefficient (ii) E_r, H_i, H_r (iii) Power in region 1. 6

c. Explain different types of wave polarization. 6

8 a. Define the terms effective aperture and directivity of an antenna. Determine the effective aperture and directivity of short dipole antenna. 10

b. A receiving antenna kept at a distance 150 kmts from the transmitting antenna receives power of 500 kW at frequency of 5 MHz. The gain of transmitting antenna is 50 and gain of receiving antenna is 25. Calculate the transmitted power. 6

c. Write note on antenna field zones. 4

UNIT - V

9 a. Explain earth's behaviour at different frequencies. Also sketch the variation of attenuation factor with numerical distance. 6

b. Derive an equation for power radiated by a current element. 8

c. Discuss the space wave propagation with related equations. 6

10 a. Discuss the effects of curved nature of earth. 6

b. Derive the equation for relative permittivity and refractive index of ionosphere. 8

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

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