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

(An Autonomous Institution affiliated to VTU, Belgaum)

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

Semester End Examination; Dec - 2016/Jan - 2017

Engineering Electromagnetics

Time: 3 hrs *Max. Marks: 100*

***Note**: i) Answer **FIVE** full questions, selecting **ONE** full question from each unit.*
ii) Assume suitable missing data, if any.

UNIT - I

1 a. State and explain Coloumb's law in vector form. Two point charges Q_1 = 50 μC and Q_2 = 10 μC are located at (-1, 1, -3) m and (3, 1, 0) m respectively. Find force on Q_1. 8

b. Derive an equation for Electric filed intensity at a point 'P' due to a finite length 'L' of line of charge density ρ_l and extend the result to obtain electric field intensity of infinite line of charge. 8

c. State and prove Gauss divergence theorem. 4

2 a. Derive the term Electric field intensity. 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*. 10

b. Define the term electric flux and electric flux density. Evaluate the amount of electric flux that passes through the portion bounding by $-1 \le y \le 2$ and $0 \le z \le 4$ in the $x = 3$ plane, if $\vec{D} = 2xy\hat{a}_x + 3yz\hat{a}_y + 4zx\hat{a}_z\ C/m^2$. 10

UNIT - II

3 a. Calculate the potential difference V_{AB} for a line charge with $\rho_l = 5\ nC/m$ on the Z-axis, where, $A\left(2m, \frac{\pi}{2}, 0\right)$ and $B(4m, \pi, 5m)$. 6

b. Explain the conservative nature of static electric field and show that E = -∇V. 6

c. *If* $V = x - y + xy + 2z\ volt$. Find $\vec{E}$ at (1, 2, 3) and energy stored in a cube of side 2 m centered at the origin. 8

4 a. State and prove Uniqueness theorem. 6

b. At the boundary between two different dielectrics, derive the relation between tangential and normal field component. 6

c. Two parallel conducting planes are separated by distance 5 mm at $z = 0$ and $z = 5$ mm. If, V = 0 at $z = 0$ and V = 100 V at $z = 5$ mm. Find the charge densities on the plates. 8

UNIT - III

5 a. Find the magnetic flux density at the centre of a square wire loop 2 m on a side carrying a current of 3 A. 8

Contd.....2

b. Explain the concept of scalar and magnetic vector potential. 7

c. State and prove Stoke's theorem. 5

6 a. Derive the equation of force between differential current elements. 7

b. Obtain magnetic torque and magnetic dipole moment for a rectangular planar coil carrying current '*I*' placed in *XY* plane and parallel to the magnetic field. 8

c. A linear conductor carries a current of 100 A in the +ve X-direction. If flux is everywhere is uniform with magnitude of B = 2.5 Wb/m^2 and has direction parallel to the XY plane at an angle of 45° with respect to X-axis. Find the magnitude and direction of force on 2 m length of conductor. 5

UNIT - IV

7 a. Derive the boundary conditions at the interface between two media of different permeabilities. 6

b. Derive the equation for self inductance of,

i) Two wire transmission line ii) Co-axial cable. 8

c. The magnetic field traverse from medium 1 to medium 2. If magnetic field intensity, $\vec{H} = -30\hat{a}_x + 50\hat{a}_y + 70\hat{a}_z$ in medium 1, μ_{r1} = 2.5, μ_{r2} = 4, boundary is at *Z* = 0. Find magnetic field intensity in medium 2. 6

8 a. Explain the concept of conduction current density and displacement current density. 7

b. List the Maxwell's equation both in integral form and differential form. 8

c. Write note on retarded potential. 5

UNIT - V

9 a. State and prove Poynting vector theorem. 7

b. A uniform plane wave with frequency 10 GHz is propagating in poleythelene for which $\mu = \mu_0$, $\varepsilon_r = 2.3$ *and* $\sigma = 2.56\times10^{-4}$ ℧/ *m.*

Calculate the,

i) Attenuation constant ii) Phase constant. 7

c. Derive the equation for the wave in free space with electric field along X-direction and magnetic field along Y-direction. 6

10 a. Explain the following types of wave polarization,

i) Linear ii) Elliptical iii) Circular. 8

b. Explain the reflection of uniform plane wave at normal incidence and show that $1 + \Gamma = \tau$ 8

c. Write a note on standing waves. 4

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