U.S.N | | | | | | | | | | |

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 - 2019

Electromagnetics 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 expression for electric field intensity along *X*-axis, due to infinite sheet of charge placed in *Y-Z* plane. 7

b. State and explain Coulomb's law in vector from. 5

c. Uniform line charge ρ_l = 25 nC/m lies on the line $X = -3$ m, $Z = 4$ m in free space. Compute the electric field intensity at a point (2, 15, 3) m. 8

2 a. Explain the term electric flux density. State and prove Gauss divergence theorem. 7

b. Calculate the charge density for the following field :

i) $D = 2xy\,\hat{a}_x + z\,\hat{a}_y + yz\,\hat{a}_z\ C/m^2$ at $P(2, -1, 3)$ 8

ii) $D = rz\sin\Phi\,\hat{a}_r + 3rz^2\cos\Phi\,\hat{a}_\Phi\ C/m^2$ at $P(5, \frac{\pi}{2}, 1)$

c. A point charge of 6 μc is located at the origin, a uniform line charge density of 180 nC/m lies along *X*- axis. Find the electric flux density at point P(1, 2, 4). 5

UNIT - II

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

b. Find the electric field strength for the following scalar fields; 6

i) $V = 4xz^2 + 3yz$ ii) $V = r^2\cos\theta\cos\phi$

c. Calculate the energy stored in a system of four identical point charges Q = 4 nC at the corners of a square of 1 m on a side. 8

4 a. Discuss the concept of scalar and vector magnetic potential. 8

b. State and prove the following :

i) Ampere's circuital law 8

ii) Biot Savart law

c. Determine, whether the potential field $V = r\cos\phi + Z$, satisfies Laplace's equation. 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. 8

b. Develop the boundary condition of B and H at the interface between two different magnetic materials. 6

c. Develop the equation for self inductance of coaxial cable. 6

Contd…2

6 a. Write Maxwell's equation both in integral form and differential form for harmonically varying fields. 8

b. Discuss the concept of displacement current density. 6

c. In a region, if $\vec{A} = 10^{-3}\, y\, cos\, 3\times10^{8}\, t\, cos\, Z\, \hat{a}_z\ \ Wb/m$, 6

$\in_r = \mu_r = 1$, $\sigma = 0$ and $V = 3\times10^5 y \sin 3\times10^8 t \sin z$ volt. Compute $\vec{E}$

UNIT - IV

7 a. State and prove Poynting's theorem starting from Maxwell's equation. 8

b. Discuss the wave propagation in good conductors with related equations. 6

c. $\vec{E}$ wave travelling in free space is incident normally on the interface with a perfect dielectric with $\in_r = 3$. Calculate the transmission coefficient and reflection coefficient. 6

8 a. Calculate the maximum effective aperture and directivity of short dipole antenna. 6

b. Derive equation for effective aperture in terms of effective height of an antenna. 6

c. Discuss the following with respect to antenna : 8

i) Antenna field Zones ii) Radiation pattern and beam width

UNIT - V

9 a. Discuss tilt of wave front due to ground losses. 5

b. Explain Electrostatic field and Induction field of alternating current element. 10

c. Explain Earths behaviour at different frequencies . 5

10 a. Discuss the mechanism of wave reflection from ionosphere. 6

b. Define the term skip distance and maximum usable frequecy. If the wave is reflected from a hieght of 300 km, N_{max} is 23.45×10^{10} and MUF is 10 MHz, calculate the skip distance for flat earth. 8

c. Discuss the effect of curved nature of earth. 6

* * * *