SE466

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S.E.(Electronics & TC / Electronics & Comm. Engg) Semester- IV (Revised Course 2007-08)
EXAMINATION MAY/JUNE 2019
Electromagnetic Fields and Waves

[Duration : 3 Hours] **[Max. Marks : 100]**

Instructions:
1) Answer **any five** questions.
2) Attempt minimum of **one** question from **each module**.
3) Assume missing data if any.
4) Figures to the **right** indicates **marks.**

MODULE-I

Q.1
a. Derive the expression for transformation of components in Cartesian coordinate systems into components in cylindrical coordinate systems. **06**
b. Give $\vec{A} = \rho \sin \emptyset \, \widehat{a_\rho} + \rho \cos \emptyset \, \widehat{a_\emptyset} - 2\, z \, \widehat{a_z}$. transform vector $\vec{A}$ into Cartesian coordinate systems. **06**
c. Find the force on a $10\mu C$ charge located at (0, 0, 5)m, if two like charges of $20\mu C$ are located on the x axis at $\pm 4m$. **04**
d. Show that $\nabla \times (\nabla V) = 0$ **04**

Q.2
a. Formulate the expression for curl in Spherical, Cylindrical and Cartesian coordinate systems. **06**
b. Find divergence of following vector fields. **08**
i. $\vec{A} = xy \, \widehat{a_x} + y^2 \, \widehat{a_y} - xz \, \widehat{a_z}$
ii. $\vec{B} = \rho^2 z \, \widehat{a_\rho} + \rho^3 \, \widehat{a_\emptyset} + 3\rho \, z^2 \, \widehat{a_z}$
c. A circular ring of radius 'a' carries a uniform charge $\rho_L \; C/m$ and is placed on the xy-plane with its axis same as the z-axis. Find electric field intensity at $(0, \Phi, h)$. **06**

MODULE-II

Q.3
a. State Gauss's law. Using the same find the electric flux density due to infinite dimension sheet charge. **06**
b. Two point charges $-4\mu C$ and $5\mu C$ are located at (2, -1, 3) & (0, 4, -2) respectively. Find the potential at (-1, 5, 2). Assume $V(\infty) = 0$. **06**
c. Derive the expression for energy density in an electrostatic field. **08**

Q.4
a. A parallel plate capacitor with distance between the plates as 4mm, contains dielectric with permittivity $\epsilon = 4\,\epsilon_0$. The potential difference between the plates is 10V. Suppose the plate at x=0 is at 0V and the plate at x=4mm is at 10V, find V(x) everywhere. **06**
b. Differentiate between conduction current and convection current. **06**
c. A homogeneous dielectric ($\epsilon_r = 2.5$) fills region $1(x < 0)$ while region 2 (x>0) is a free space **08**

i. If $\overrightarrow{D1} = (12\widehat{a_x} - 10\widehat{a_y} + 4\widehat{a_z})nC/m^2, find\ \overrightarrow{D2} and\ \theta 2.$

ii. If $E2 = 12\ V/m\ and\ \theta 2 = 60^0, find\ E1\ and\ \theta 1.$

MODULE-III

Q.5

a. State and explain Biot-Savart Law of magnetostatics. **06**

b. State Ampere's law. Find magnetic field intensity due to an infinite length long conductor carrying current I. **06**

c. Starting from Ampere's law derive the Maxwell's equations in point and integral form for time varying fields. **08**

Q.6

a. Derive the magnetic boundary conditions. **06**

b. A filamentary loop carrying current I is bent to assume the shape of a regular polygon of 'n' sides. Show that at the center of the polygon the magnetic field intensity is, **08**

$$\vec{H} = \frac{nl}{2\pi r}\sin\left(\frac{\pi}{n}\right)$$

Where 'r' is the radius of the circle circumscribed by the polygon.

c. Derive the expression for force between two current elements. **06**

MODULE-IV

Q.7

a. Derive the time dependent source free electromagnetic wave equation for electric field intensity. **08**

b. Explain the wave propagation through Lossless medium. **08**

c. Determine $\beta, \alpha, \lambda, v$ for rubber at $f = 10^{16} Hz$. **04**
Given $\epsilon_r = 4, \sigma = 10^{-16}\ S/m\ and\ \mu_r = 1$

Q.8

a. State and prove Poynting theorem. Give its significance. **08**

b. Derive the reflection and transmission coefficient of uniform plane wave for normal incidence. **06**

c. What is wave polarization? Explain circular polarization. **06**