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

[Duration : Three Hours]

[Max. Marks : 100]

Instruction

- 1) Answer **any five** questions.
- 2) Attempt minimum of **one** questions 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. [6 M]
 - b) Given $\vec{A} = y \hat{a}_x + (x + z) \hat{a}_y$ Transform vector \vec{A} into spherical coordinate systems. [6 M]
 - c) State and explain Coulomb's law of electrostatics [4 M]
 - d) Show that $\nabla \cdot (\nabla \times \vec{A}) = 0$ [4 M]
- Q.2
- a) Find divergence and curl of the following vector fields and hence specify whether the given vector field is Solenoidal or non-solenoidal and Rotational or irrotational. [6 M]
 - i) $\vec{A} = x \hat{a}_x + y \hat{a}_y$
 - ii) $\vec{B} = y \hat{a}_x + y \hat{a}_z$
 - b) Evaluate both sides of divergence theorem and verify the same for $\vec{D} = \rho^2 \cos^2(\theta) \hat{a}_\rho + z \sin(\theta) \hat{a}_\theta$ over the closed surface of the cylinder specified by $0 \leq z \leq 1, \rho = 4$. [6 M]
 - c) Find gradient of $V = e^{-z} \sin(2x) \cos(y)$
 - d) Point charges 5nC and -2nC are located at (2, 0, 4) and (-3, 0, 5) respectively. Determine the force on a 1nC point charge located at (1, -3, 7) [4 M]
[4 M]

MODUL - II

- Q.3
- a) State Gauss's law. Using the same find the electric flux density due to infinite dimension sheet charge. [6 M]
 - b) A point charge of 5nC is located at the origin. find potential at A(-3,2,6) [4 M]
 - c) Derive the expression for energy density in an electrostatic field. [6 M]
 - d) Derive the relationship between \vec{E} & V [4 M]
- Q.4
- a) Conducting spherical shells with inner radius 'a' and outer radius 'b' are maintained at a potential difference of V_0 , such that $V_{(r=b)} = 0$ and $V_{(r=a)} = V_0$ Determine \vec{E} & V in the region between the shells. [8 M]

- b) Derive continuity equation. [4 M]
 c) Derive the boundary conditions for electric field for the interface between dielectric – dielectric interfaces. [8 M]

MODULE –III

- Q.5 a) State and explain Biot- Savart Law of Magnetostatics, [6 M]
 b) A wire of infinite length and radius 'a' carries a current I. calculate magnetic field intensity \vec{H} everywhere using Ampere's law Also sketch for \vec{H} as a function of distance from the center of the conductor. [6 M]
 c) List the Maxwell's equations for time varying fields in both point and integral form. Give its significance. [8 M]
- Q.6 a) Give the classification of magnetic materials. Explain each of them. [8 M]
 b) Derive the expression for vector magnetic potential. [8 M]
 c) A conductor 4m long lies along the y-axis with a current of 10A in the \hat{a}_y direction. [4 M]
 Find the force on the conductor if the field in the region is $\vec{B} = 0.05\hat{a}_x$ Tesla.

MODULE- IV

- Q.7 a) Derive the time dependent source free electromagnetic wave equation for magnetic field intensity. [8 M]
 b) Explain the wave propagation through Good conductor. What is skin depth? Give its significance. [8 M]
 c) Determine $\beta, \alpha, \lambda, v$ for rubber at $f = 10^{16} \text{ Hz}$. Given $\epsilon_r = 3.5, \sigma = 10^{-16} \text{ S/m}$ and $\mu_r = 1$ [4 M]
- Q.8 a) State and prove Poynting theorem. Give its significance. [8 M]
 b) Find the reflection and transmission coefficient of uniform plane wave travelling in air and inclined normally on a boundary between air and dielectric having $\mu = \mu_0$ and $\epsilon = 4 \epsilon_0$. [6 M]
 c) What is wave polarization? Explain elliptic polarization. [6 M]