Code : 103307

2013 (A)

ELECTROMAGNETIC FIELD THEORY

Time : 3 hours *Full Marks* : 70

Instructions :

(i) The marks are indicated in the right-hand margin.

*(ii) There are **TEN** questions in this paper.*

*(iii) Attempt any **FIVE** questions.*

1. *(a)* Find the potential distribution due to a long pair of parallel wires of negligible cross-section and having equal and opposite line charge density. Also obtain equipotential surfaces produced by them.

   (b) Find the capacitance of two parallel cylindrical conductors having their radii as a and separation between their axes as b. 9+5=14

2. *(a)* State uniqueness theorem and prove it.

   (b) Explain conductor properties and obtain boundary conditions.

   (c) For a two-dimensional system in which $r = \sqrt{x^2 + y^2}$, determine $\nabla^2 V$ when $V = \frac{1}{r}$. 6+5+3=14

3. *(a)* Find the energy density in the magnetic field.

   (b) Find the magnetic field inside a solid conductor carrying a direct current, and hence obtain total magnetic flux per unit length within the conductor.

   (c) Prove Stokes' theorem. 5+5+4=14

4. *(a)* Obtain two Maxwell's equations which deviate from steady-state field.

   (b) The electric field of electromagnetic wave is given by $E_x = 0 = E_z$, $E_y = A\cos\omega\left(t - \frac{z}{c}\right)$. Using Maxwell's equation in free space, find the magnetic vector $\vec{H}$. 9+5=14

Find the ratio of $\vec{E}$ and $\vec{H}$ in a uniform plane wave.

(b) Discuss the wave propagation in conducting medium and obtain the value of α and β. 8+6=14

6. Derive the reflection coefficient of perfect dielectric for oblique incidence in the case of parallel polarization. Obtain Brewster angle. 14

State Poynting theorem and prove it.

(b) A short vertical transmitting antenna erected on the surface of a perfectly conducting earth produces effective field strength

$$E_{eff} = E_{\theta\, eff} = 100 \sin\theta \frac{mu}{m}$$

at points at a distance of one mile from the antenna. Compute the Poynting vector and total power radiated. 9+5=14

8. (a) Discuss UHF line as circuit element and hence find the input impedance of short-circuited quarter-wave line.

(b) Discuss quarter-wave line as transformer. 8+6=14

Discuss Smith chart and its uses.

(b) Design a necessary matching unit to join without impedance mismatch the two different sections of transmission line whose impedances are 75 ohm and 50 ohm. 10+4=14

10. Find the field component of TM wave in parallel plane guide and hence discuss TEM wave. 14

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