

Total number of printed pages – 4

B. Tech
CPEE 5307

Sixth Semester Examination – 2008

ELECTROMAGNETIC THEORY

Full Marks – 70

Time : 3 Hours

Answer Question No. 1 which is compulsory
and any **five** from the rest.

The figures in the right-hand margin
indicate marks.



1. Explain the following : 2 × 10
- (a) Can Stoke's theorem be applied to closed surfaces ?
- (b) What is the significance of a zero vector ?
- (c) What do we mean when we say that an object is charged ?
- (d) Why is the electric field intensity not zero in a steady current carrying current ?

- (e) When can we use Ampere's circuital law to determine the magnetic field ?
- (f) What is the significance of $\text{div. } (\mathbf{B}) = 0$?
- (g) What is meant by depth of penetration ?
- (h) Is it necessary for the fields to satisfy Maxwell's equations in order to exist ?
- (i) What is meant by a retarded field ?
- (j) What is a uniform linear array ?
- (a) Using the rectangular coordinate system, verify that (i) $\text{div. } (\text{curl } \mathbf{A}) = 0$ (ii) $\text{curl } (\text{grad } f)$ 6
- (b) Express the position vector $\mathbf{r} = x \mathbf{a}_x + y \mathbf{a}_y + z \mathbf{a}_z$ in the spherical coordinate system. 4
3. (a) Show that the equipotential surfaces for an infinite uniformly charged line are concentric cylinders. 4
- (b) A long spherical cloud of radius 'b' has a uniform volume charge distribution of ρ_v .

P.T.O.

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2

Contd.

Calculate and sketch the potential distribution and also electric field intensity at any point in space using Poisson's and Laplace's equation. 6

4. The conductivity of a homogeneous conducting medium, bounded by $10 \text{ cm} \leq r \leq 20 \text{ cm}$, $30^\circ \leq \theta \leq 45^\circ$ and $30^\circ \leq \phi \leq 60^\circ$ is 0.4 S/m . The surface at $\theta = 45^\circ$ is at a ground potential, and the surface at $\theta = 30^\circ$ is at 100 V . Using Laplace's equation, determine the resistance of the medium, neglecting the edge effects. 10
5. (a) What do you mean by magnetic vector potential? How is it different from magnetic scalar potential? Can you derive the Biot-Savart law from the magnetic vector potential? 5
- (b) A straight wire extends from $z = -L$ to $z = L$ and carries a current I . What is the \mathbf{B} field in a plane bisecting the wire? 5

6. State and explain the conditions of the electromagnetic fields at the interface between
- (a) dielectric – dielectric and
- (b) dielectric – conductor boundaries. 10
7. (a) Explain the polarization of a wave. What is the major difference between the elliptically and circularly polarized waves? 5
- (b) In a dielectric medium $\epsilon = 9\epsilon_0$, $\mu = \mu_0$ a plane wave with $\mathbf{H} = 0.2 \cos(10^9 t - kx - k\sqrt{8}z) \mathbf{a}_y \text{ A/m}$ is incident on an air boundary at $z = 0$, find (i) the incident \mathbf{E} (ii) the transmitted and reflected \mathbf{E} and (iii) \mathbf{k} . 5
8. What is the difference between directive gain and directivity? Find the directive gain of the Hertzian dipole and compare with that of the half-wave dipole. 10

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