

(Following Paper ID and Roll No. to be filled in your Answer Book)

**PAPER ID : 2110**

Roll No.

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**B.Tech**  
**(SEMESTER-V) THEORY EXAMINATION, 2012-13**  
**FUNDAMENTALS OF E.M. THEORY**

*Time : 2 Hours ]*

*[ Total Marks : 50*

**Note :** This questions paper has **three** sections. Section I is compulsory.

**Section – I**

Attempt **all** parts of the following :

**10 × 1 = 10**

- (i) Define Coulomb's law.
- (ii) Define electric field intensity.
- (iii) Write Poisson's and Laplace's equations.
- (iv) Write the boundary conditions at the interface between two perfect dielectrics.
- (v) Mention the properties of uniform plane waves.
- (vi) Define Poyntings theorem.
- (vii) State Maxwell's fourth equation.
- (viii) What will happen when the wave is incident obliquely over dielectric-dielectric boundary ?
- (ix) Define imperfect dielectrics.
- (x) Why water has much greater dielectric constant than mica ?

**Section – II**

2. Attempt **three** parts from this section :

**3 × 5 = 15**

- (a) Derive an expression for displacement and conduction current densities. Also obtain an expression for continuity current relation.
- (b) Briefly explain reflection by a perfect dielectric when a wave is incident normally on a perfect conductor.

- (c) State and explain Faraday and Lenz law of induction and derive Maxwells' equation.
- (d) Derive an expression for energy and energy density in a magnetic field.
- (e) The electric vector E of an electromagnetic wave in free space is given by the expression

$E_x = E_z = 0, E_y = A \cdot \cos w \left( t - \frac{z}{c} \right)$  using Maxwell's equations for free space conditions determine expressions for the components of the magnetic vector H.

### Section – III

**Note :** Attempt **all** parts of the following :

**5 × 5 = 25**

3. Four positive charges of  $10^{-9}$  C each are situated in XY plane at points (0, 0), (0, 1), (1, 0) and (1, 1). Find electric field intensity and potential at  $\left( \frac{1}{2}, \frac{1}{2} \right)$ .
4. What do you mean by uniform plane waves ? Derive for intrinsic impedance of free space is  $\eta_0 = \sqrt{\frac{\mu_0}{\epsilon_0}} = 377 = 120\pi \Omega$ .
5. What do you mean by displacement current ? Derive.  

$$\nabla \times H = J + \frac{\partial D}{\partial t}$$
6. What do you mean by plane wave dispersion ? Explain in detail.
7. Explain the nature and behaviour of magnetic material. Write Laplace's and Poisson's equations for steady magnetic field.
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