

THEORY EXAMINATION (SEM-IV) 2016-17
ELECTROMAGNETIC FIELD THEORY

Time : 3 Hours

Max. Marks : 100

Note : Be precise in your answer. In case of numerical problem assume data wherever not provided.

SECTION – A

1. Attempt all parts of the following questions: 10 x 2 = 20
- Explain the physical significance of Divergence and Curl.
 - Derive an expression for inductance per unit length of coaxial conductors.
 - Express $B = \left(\frac{10}{r}\right) r + r \cos \theta$ in cylindrical coordinates.
 - Explain the terms – Transmission coefficient and reflection coefficient.
 - Prove the electric field vector $E = (\text{grad } V)$, where V is a scalar potential field.
 - Transform the point (1, 1, 6) to spherical coordinates.
 - Verify whether the scalar field $S = \rho^2 z \cos 2\Phi$ in cylindrical coordinates is a solution of Laplace's equation.
 - A copper wire carries a conduction current of 1 amp at 60 Hz. What is the displacement current in the wire? Assume $\mu = \mu_0$, $\epsilon = \epsilon_0$ and $\sigma = 5.8 \times 10^7$ ohm/m.
 - State Stoke's theorem and Divergence theorem.
 - State the Gauss's law and derive the related Maxwell equation.

SECTION – B

2. Attempt any five of the following questions: 5 x 10 = 50
- Derive and explain the mathematical form of Poynting theorem.
 - Given that $D = \left(\frac{5r^2}{4}\right) r$ in spherical co-ordinate. Find the volume enclosed between $r=1$ and $r=2$.
 - Explain the phenomenon of polarization and its types.
 - Prove that the magnetic field due to an infinite conductor carrying current i at a distance r is $H = \frac{i}{2\pi r}$ A/m.
 - Explain the tangential and normal boundary conditions between two dielectrics for static electric fields.
 - Calculate E at $P(1, 1, 1)$ in free space caused by four identical 3-nC point charges located at $p_1 = (1, 1, 0)$, $p_2 = (-1, 1, 0)$, $p_3 = (-1, -1, 0)$ and $p_4 = (1, -1, 0)$.
 - State and explain Maxwell's equations for time varying fields in differential and integral forms and their significance.
 - A uniform plane wave propagating in good conductor. If the magnetic field intensity is given by $H = 0.1e^{-15} \cos(2\pi \times 10^8 t - 15z) i$ A/m, determine the conductivity and corresponding component of E field. Also calculate the average power loss in a block of unit area and thickness t .

SECTION – C

- Attempt any two of the following questions: 2 x 15 = 30
- A uniform plane wave propagating in a medium has $E = 2e^{-az} \sin(10^8 t - \beta z) j$ V/m. If a medium is characterized by $\epsilon_r = 1$, $\mu_r = 20$ and $\sigma = 3$ S/m, determine α , β and H .
 - Discuss the solution of plane wave equation in conducting media (Lossy Dielectric). Derive the above up to Propagation Constant. Attenuation Constant and Phase Constant.
 - Explain the reflection of plane wave for the normal incidence. Discuss about Reflection and Transmission coefficient for E and H .