OR

Derive electromagnetic wave equation for a conducting medium Derive vector Helmholtz equation.

Unit - V

a) What is frequency dispersive propagation?

b) Define phase velocity and group velocity?

c) What is magnetic vector potential?

d) Give mathematical analysis of Brewster's angle?

OR

Give mathematical analysis for reflection at the surface of a conductive medium of e.m. waves.

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Roll No ....

EC - 402
B.E. IV Semester
Examination, June 2016
Electro-Magnetic Theory
Time : Three Hours

Maximum Marks : 70

Note: i) Answer five questions. In each question part A, B, C is compulsory and D part has internal choice.

ii) All parts of each question are to be attempted at one place.

iii) All questions carry equal marks, out of which part A and B (Max. 50 words) carry 2 marks, part C (Max. 100 words) carry 3 marks, part D (Max. 400 words) carry 7 marks.

iv) Except numericals, Derivation, Design and Drawing etc.

Unit - I

1. a) Write formula for divergence in curtain, cylindrical and spherical co-ordinate systems?

   b) What is electric field intensity?

   c) Find the work done in moving a point charge $Q = -20$ µc from the origin to (4, 0, 0) m in the field

   $$\vec{E} = \left(\frac{x}{2} + 2y\right)\overrightarrow{ax} + \partial \mid \tau . \overrightarrow{ay} V / m.$$

   d) Calculate the potential at a point

   i) Outside

   ii) Inside a uniformly charged sphere of radius = (a)

OR

Solve Laplace's equation for the region between co-axial cones. Given at $\theta = \theta_1$, $V = V_1$ and $\theta = \theta_2$, $V = 0$. The cone vertices are insulated at $r = 0$.
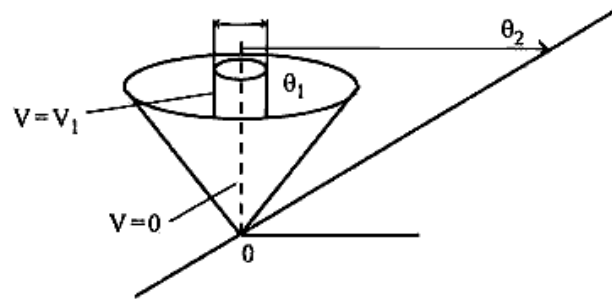
Define potential function and potential difference?

Unit - II

2. a) Write expression for capacitance of an isolated sphere.

   b) Derive Poisson's equation and Laplace's equation.

   c) Calculate the potential at $r_A = 3m$ w.r.t $r_B = 9$ m due to a point charge $Q = 500$ PC at the origin and zero reference at infinity.

   d) Derive expression for energy stored and energy density in a magnetic field? Calculate the magnetic flux density at the centre of a current carrying loop when the loop radius is 2 cm loop current is 1 mA and the loop is placed in air.

OR

Derive expressions for inductance of

   i) Solenoid

   ii) Toroid of circular cross-section

   iii) Toroid of rectangular cross-section

   iv) Co-axial cable.

Unit - III

3. a) Calculate the skin depth in copper at 10 GHz. Assume conductivity of copper $\sigma = 5.8 \times 10^7$ mhos/m and permeability equal to that of free space?

   b) Derive expressions for Instantaneous poynting vector.

   c) Derive expressions for energy stored and energy density in static electric field.

   d) Derive wave equations for non-conducting medium?

OR

   • Give a general solution of Maxwell's equations w.r.t. uniform plane waves?

Unit - IV

4. a) Calculate the phase velocity and the magnitude of the attenuation constant of plane wave at a frequency of 10 GHz in polyethene. It is given that $\mu = \mu_0$, $\epsilon_r = 2.3$ and $\sigma = 2.56 \times 10^{-4}$ mhos/m.

   b) What do you mean by horizontal polarization?

   c) If a parallel polarized electromagnetic wave is incident from air on to the surface of

   i) Paraffin with $\mu_r = 1$, $\epsilon_r = 2.1$

   ii) Flint glass with $\mu_r = 1$, $\epsilon_r = 10$

   iii) Distilled water with $\mu_r = 1$, $\epsilon_r = 81$. Find the Brewster angle θ_{iB} in each of the cases.

   d) Give mathematical analysis of elliptical polarization.