OR

Prove that $\vec{P} = \vec{E} \times \vec{H}$ *where* $\vec{P}$ is pointing vector in watts/m² and $\vec{E}$ and $\vec{H}$ are electric and magnetic fields respectively.

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Roll No .....

EX - 302

B.E. III Semester

Examination, June 2015

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.

1. a) State coulomb law.

b) Describe the divergence and curl of vector field. Explain the physical significance of divergence and curl of a vector field.

c) Define electric field intensity. Derive the relation between electric field and electric potential in differential form. Also represent the same in cylindrical and spherical co-ordinates.

d) State and prove the stroke's theorem.

OR

Transform the vector field $\vec{F} = 10\vec{a}_x - 8\vec{a}_y + 6\vec{a}_z$ to cylindrical coordinate system, at point P(10, –8, 6).

2. a) Drive Poisson's and Laplace equations.

   b) Define magnetic flux. Flux density and magnetic field intensity.

   c) The volume charge density of a spherical body of radius 'a' centred at the origin is given by.

   $\rho_v(r,\theta,\varphi) = \frac{\rho_0}{r}\ coulomb/m^2$, Where ρ_0 is constant, calculate the total charge in the sphere.

   d) Derive an expression for potential and electric field due to dipole.

   OR

   Find V at P (2, 1, 3) for the field of two infinite radial conducting planes with V=50v at ϕ=10°and V=20v at ϕ=30°.

3. a) State and explain Biot - Savarts law.

   b) Derive the expression for force between two current carrying wires.

   c) State and explain the boundary conditions for electrical fields at an interface between two dielectrics.

   d) Drive the expression for Ohm law in point form and continuity equation.

   OR

   Define the electric dipole and dipole moment. Drive the relation for potential and electric field intensity due to a dipole.

4. a) Derive an expression induction of the solenoid and toroid.

   b) What are the conduction current density and convection current density? Explain with help of suitable example.

   c) Determine scalar magnetic potential vector magnetic potential self and mutual induction.

   d) Write Maxwell's equation. How these are to be modified in free space and harmonically verify fields.

   OR

   State and prove Poynting vector theorem. Also give the expression for Average and Complex Pointing vector.

5. a) Define Skin depth.

   b) Derive the EM wave equation.

   c) What is meant by polarization of a wave? When is a linearly polarized? When a wave is circularly polarized.

   d) A lossless dielectric medium has $\sigma=0, \mu_r=1$ and $\varepsilon_r = 4$. An EM wave has magnetic field

   $\overrightarrow{H} = -0.1\cos(\omega t - z)\overrightarrow{a_x} + 0.5\sin(\omega t - z)\overrightarrow{a_y} A/m.$

   Find

   i) Phase constant

   ii) Angle velocity

   iii) Wave impedance

   iv) The component of the electric field intensity of the wave.