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06ES36

Third Semester B.E. Degree Examination, January 2013
Field Theory

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions, selecting atleast TWO questions from each part.***

PART - A

1 a. Define the following : i) Coulomb's law ii) Electric field intensity iii) Gauss law. **(06 Marks)**

b. State the prove divergence theorem. **(06 Marks)**

c. Let $\vec{D} = 5r^2\, a_r$ mc / mt^2 for r < 0.08mt and $\vec{D} = \frac{0.1}{r^2} a_r$ mc/mt^2 for r > 0.08 mt. Find ρ_v for i) r = 0.06 mt ii) r = 0.1 mt. **(08 Marks)**

2 a. An electric potential is given by $V = \frac{60 \sin\theta}{r^2}$. Find v and $\vec{E}$ at $(3, 60^0, 25^0)$. **(08 Marks)**

b. Derive the integral and point form of continuity equation. **(06 Marks)**

c. Derive the boundary conditions for perfect dielectric materials of permitivities ϵ_1 and ϵ_2. **(06 Marks)**

3 a. Obtain Poisson's and Laplace's equations from Maxwell's first equation. **(06 Marks)**

b. Verify that the potential field given below satisfy Laplace's equation. $V = 2x^2 - 3y^2 + z^2$. **(06 Marks)**

c. Derive the expression for capacitance of a co – axial cable using Laplace's equation. **(08 Marks)**

4 a. State and explain Biot – Savart law. Using this, find the magnetic flux density at the centre of a circular loop of radius 'a' mt. **(08 Marks)**

b. Magnetic field intensity in free space is $\vec{H} = 10\rho^2\, a_\phi$ A/mt. Determine i) $\vec{J}$ ii) Integrate over the circular surface ρ = 1mt all ϕ and Z = 0. **(06 Marks)**

c. Explain scalar and vector magnetic potentials. **(06 Marks)**

PART - B

5 a. Derive the equation for magnetic force between two differential current elements. **(06 Marks)**

b. Given the ferrite material which is to be operating in a linear mode with $\vec{B}$ = 0.05T and μ_R = 50. Calculate the values for χm, $\vec{M}$ and $\vec{H}$. **(06 Marks)**

c. Define self inductance. Find the same of a Solenoid with air core has 200 turns and a length of 60cm core with radius 3cm. Derive the formula used. **(08 Marks)**

6 a. Derive the Maxwell's equation in point form as derived from Faraday's law. **(06 Marks)**

b. Determine the frequency at which conduction current density and displacement current density are equal in a medium with $\sigma = 2 \times 10^{-4}$ S/mt and $\epsilon_r = 81$. **(06 Marks)**

c. List the Maxwell's equation in differential and integral form as applied to time – varying fields. **(08 Marks)**

7 a. Discuss the uniform plane wave propagation in a good conducting medium. **(06 Marks)**

b. A 9375 MHz uniform plane wave is propagating in polystyrene ($\mu_r = 1$, $\epsilon_r = 2.56$). If the amplitude of electric field intensity is 20V/mt and the material is assumed to be lossless. Find i) Phase constant ii) Wavelength iii) Velocity of propagation iv) Intrinsic impedance v) Magnetic field intensity. **(10 Marks)**

c. State and explain Poynting theorem. **(04 Marks)**

8 a. Define Standing wave ratio (SWR). Find the value of SWR when reflection co-efficient (Γ) $= \pm \frac{1}{2}$. **(04 Marks)**

b. Derive the expressions for transmission co – efficient and reflection co – efficient. **(08 Marks)**

c. Determine the reflection co – efficient and transmission co – efficient for a wave traveling in air and incident on a dielectric medium with $\mu = \mu_0$ and $\epsilon_r = 4$. Also find out average incident, reflected and transmitted powers. Show that average power is conserved. **(08 Marks)**

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