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10EE44

Fourth Semester B.E. Degree Examination, July/August 2021
Field Theory

Time: 3 hrs. Max. Marks:100

Note: ***Answer any FIVE full questions.***

1 a. Define Electric field Intensity (E), find an expression for electric field intensity to 'N' different point charges. **(06 Marks)**

b. State and prove Gauss-Divergence Theorem. **(08 Marks)**

c. A charge of 10nc is located at a point P_1 (0, 0, 5) and another charge of 5nc located at a point P_2 = (0, 0, -5), find the coordinates of the point at which E = 0. **(06 Marks)**

2 a. With usual notation prove that $E = -\nabla V$. **(06 Marks)**

b. Derive Boundary conditions for conductor and Di-electric interface. **(08 Marks)**

c. At the boundary between glass ($E_r = 4$) and air the lines of electric field makes an angle of 40° with normal. If electric flux density in air is $0.25\mu c.m^2$. Determine the orientation and magnitude of electric flux density on glass. **(06 Marks)**

3 a. State and prove uniqueness theorem. **(08 Marks)**

b. Solve the Laplace equation for the pot, field and find the capacitance for a cylinder with radii a and b. Such that b > a, if v = 0, at r = b and v = v_0 at r = a. **(06 Marks)**

c. Given the potential field, $V = [A\rho^4 + B\rho^{-4}]\sin 4\phi$. S.T $\nabla^2 V = 0$ and find A and B such that V = 100V and $\vec{E} = 500V/m$ at coordinates. P[ρ = 1, ϕ = 22.5, z = 2]. **(06 Marks)**

4 a. State and prove Strokes theorem. **(08 Marks)**

b. Show that curl.H = J in a steady magnetic field. **(08 Marks)**

c. A $\vec{H}$ due to a current source is given by $\vec{H} = y\cos(2x)\hat{a}_x + (y + e^x)\hat{a}_z$. Describe the current density over the y-z plane. **(04 Marks)**

5 a. State and explain Lorentz force equation. **(08 Marks)**

b. Derive an equation of inductance of a solenoid. **(08 Marks)**

c. A solenoid with air core has 4000 turns and a length of 800mm, core radius is 50mm, find its inductance. **(04 Marks)**

6 a. Write Maxwell's equation on integral form for time varying fields. **(04 Marks)**

b. Starting from Faraday's Law of electromagnetic Induction. Derive $\nabla \times \vec{E} = \frac{-\partial \vec{B}}{\partial t}$. **(08 Marks)**

c. A certain material has σ = 0, μ_R = 1 of E = 800 Sin(10^6t – 0.01z)ay V/m. Make use of Maxwell equation to find E_R and H(z, t). **(08 Marks)**

7 a. State and prove Poynting's Theorem [P = E×H]. (08 Marks)

b. Starting from Maxwell's equation, Derive the wave equation for a uniform plane wave travelling in free space. (07 Marks)

c. A plane wave of 16GHz frequency and E = 10V/m propagates through body of salt water having constants $\epsilon_r = 100$, $\mu_r = 1$, $\sigma = 100$ ℧/N. Determine attenuation constant (α), phase shift constant, phase velocity and intrinsic Impendence of the medium. (05 Marks)

8 a. Define :

i) Reflection coefficient
ii) Transmission coefficient
iii) Loss Tangent
iv) Standing wave and wave ratio (04 Marks)

b. Derive an expression for Reflection of a Plane wave of a perfect conductor surface. (08 Marks)

c. A 1MHz uniform plane wave is normally incident on a fresh water lake of $\epsilon_r = 78$, $\mu_r = 1$ Determine the fraction of the incident power ie, Reflected, Transmitted and Determine the amplitude of Electric Field that is transmitted into the lake. (08 Marks)

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