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06ES36

Third Semester B.E. Degree Examination, Dec. 07 / Jan. 08
Field Theory

Time: 3 hrs. Max. Marks:100

Note : 1. ***Answer any FIVE full questions.***
2. ***Assume any missing data suitably.***

1 a. State and explain Gauss Law. Find out the relation between D and E. **(06 Marks)**

b. Charge is distributed uniformly along an infinite straight line with constant density ρ_l. Develop the expression for E at the general point P. **(06 Marks)**

c. A vector field is given by, $A(r,\phi,z)=30e^{-r}a_r-2za_z$. Verify the divergence theorem for the volume enclosed by, $r=2$, $z=5$. **(08 Marks)**

2 a. If $E=-8xya_x-4x^2a_y+a_z(V/m)$. Find the work done in carrying a 6 coulomb charge from A(1, 8, 5) to B(2, 18, 6) along the path $y=3x+2$, $z=x+4$. **(08 Marks)**

b. A potential function is $v=2x+4y$ volts, is in free space. Find the stored energy in free space in the 1 m^3 volume centered at origin. **(06 Marks)**

c. Starting with principle of charge conservation, obtain point form of continuity equation. **(06 Marks)**

3 a. Obtain the conditions on the tangential and normal components of electric field intensity and electric flux density at the boundary between two dielectric media. **(08 Marks)**

b. Derive Poisson's and Laplace's equations starting from point form of Gauss law. **(06 Marks)**

c. State and explain uniqueness theorem. **(06 Marks)**

4 a. Find H at the centre of a square current loop of side 4 meters, if a current of 5 amp is passing through it. **(08 Marks)**

b. State and explain Ampere's circuit law. **(06 Marks)**

c. Given $A=(y\cos ax)a_x+(y+e^x)a_z$, find $\nabla\times A$ at the origin. **(06 Marks)**

5 a. Derive Lorentz force equation and mention the application of its solution. **(06 Marks)**

b. Define torque. Find the torque about the z-axis for a conductor located at $x=0.4$ m, $y=0$ and $0 < z < 2$m, which carries a current of 5A in the a_z direction, along the length of the conductor. $B=2.5a_z$ Tesla. **(06 Marks)**

c. Derive the expression for the inductance of a toroidal ring with N turns and carrying current I amp. Assume the radius of the toroid be 'R' m and area of cross section of toroidal ring be 'A' m^2. **(08 Marks)**

6 a. State and explain Faraday's law for EMF when a closed conductor single loop circuit is placed in time varying magnetic field and hence show that $\nabla\times E=-\partial B/\partial t$. **(07 Marks)**

b. Write Maxwell's equations for free space in point and integral forms. **(08 Marks)**

c. Write a short note on retarded potentials. **(05 Marks)**

7 a. What is uniform plane wave? Explain its propagation in free space with necessary equations. **(08 Marks)**

b. What is loss tangent? Explain its practical importance. **(06 Marks)**

c. Find the skin depth δ at a frequency of 1.6 MHz in aluminium, where σ = 38.2 MS/m and $\mu_r=1$. Also find γ, λ and V_p. **(06 Marks)**

8 a. Define the terms i) Reflection co-efficient and ii) Transmission co-efficient. Also bring out the relation between them. **(08 Marks)**

b. Write a short note on SWR. **(05 Marks)**

c. A 50 MHz uniform plane wave has electric field amplitude 10 V/m. The medium is lossless, having $\in_r=9$ and $\mu_r=1$. The wave propagates in the x, y plane at a 30° angle to the x axis and is linearly polarized along z. Write down the phasor expression for the electric field. Also find λ_x, λ_y, V_{px} and V_{py}. **(07 Marks)**