Seat No.: _____ Enrolment No._____

GUJARAT TECHNOLOGICAL UNIVERSITY

B.E. Sem-Vth Examination December 2010

Subject code: 151002

Subject Name: Engineering Electromagnetics

Date: 15 /12 /2010 **Time: 03.00 pm - 05.30 pm**

Total Marks: 70

Instructions:

1. **Attempt all questions.**
2. **Make suitable assumptions wherever necessary.**
3. **Figures to the right indicate full marks.**

Q.1 **(a)** Answer the following in brief **08**

(i) 'The divergence of the curl of a vector is zero'-Justify the statement with one example.

(ii) Find the a_y dot a_ϕ and a_x dot a_θ

(iii) Given 60 μC point charge located at the origin, find the total electric flux passing through that portion of the sphere r=26 cm bounded by $0<\theta<\pi/2$ and $0<\phi<\pi/2$.

(iv) For a coaxial cable find the electric field density inside the inner core, in between inner and outer core and outside the cable.

(b) Answer the following **06**

(i) What is Gradient? with help of gradient prove that $\nabla = -$ V

(ii) Find the volume charge density that is associated with $D = \rho z^2 \sin^2\phi\ a_p + \rho z^2 \sin\phi\cos\phi\ a_\phi + \rho^2 z \sin^2\phi\ a_z$ c/m^2

Q.2 **(a)** Derive the electric field intensity and electric field density due to an infinite and uniform line charge density. **07**

(b) In the space, a line charge ρ_L=80 nC/m lies along the entire Z-axis, while point charge of 100 nC each are located at (1,0,0) and (0,1,0). Find the potential difference V_{PQ} given P (2,1,0) and Q (3,2,5). **07**

OR

(b) Given the flux density $D = (2\cos\theta/r^3)\ a_r + (\sin\theta/r^3)\ a_\theta$ c/m^2, evaluate both sides of the divergence theorem for the region defined by $1< r < 2$, $0 < \theta < \pi/2$, $0< \phi< \pi/2$ **07**

Q.3 **(a)** Describe the boundary condition between free space and conductor. What is an importance of boundary condition? **07**

(b) Write Maxwell's equations in point form and explain physical significance of equations. **07**

OR

Q.3 **(a)** Derive Poisson's and Laplace's equations and states their applications. **07**

(b) Write Maxwell's equations in integral form and explain their physical significance. **07**

Q.4 **(a)** State and explain Ampere's circuital law. Find the magnetic field intensity due to long straight conductor using Ampere's circuital law. **07**

(b) A charge of 10 nC is moving with a velocity of $10^7(-0.5\ a_x + a_y - 0.71\ a_z)$ m/s. Determine the force exerted on the test charge when **07**

(i) a magnetic induction $B = (a_x + 2a_y + 3\ a_z)$ mWb/m^2 is applied

(ii) an electric field $E = (3a_x + 2a_y + a_z)$ kV/m is applied.

(iii) When B and E given above are applied simultaneously.

OR

Q.4 **(a)** What is curl? With help of curl meter explain the physical interpretation of curl and state its applications. **07**

(b) A filamentary current of 10 A is directed in from infinity to the origin on the positive x axis, and then back to infinity along the positive y axis. Use the Biot-Savart law to find H at P (0,0,1) **07**

Q.5 **(a)** Define and explain the following terms: **07**

(i) Magnetization (ii) Polarization

(iii) Skin effect and (iv) Standing wave ratio

(b) Write short note on: **07**

(i) Wave motion in free space

(ii) Magnetic boundary condition

OR

Q.5 **(a)** Define and explain the following terms: **07**

(i) Poynting Vector (ii) The scalar and Vector magnetic potential

(iii)Hall effect (iv) Retarded Potential

(b) (i) Transform the $5a_x$ vector to spherical coordinate at A(x = 2,y = 3, z = -1). **07**

(ii) Given $V = (10/r^2)\sin\theta\cos\phi$, Find the electric flux density at $(2, \pi/2, 0)$

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