4E 4133

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B.Tech. IV Semester (Main/Back) Examination, June/July - 2015

Electronics and Communication Engineering

4EC4A Electromagnetic Field Theory

Time : 3 Hours **Maximum Marks : 80**

Min. Passing Marks : 26

Instructions to Candidates:

*Attempt any **five questions**, selecting **one question** from **each unit**. All questions carry **equal marks.** (Schematic diagrams must be shown wherever necessary. Any data you feel missing suitably be assumed and stated clearly. Units of quantities used/calculated must be stated clearly.)*

Unit - I

1. a) Transform the vector $\vec{A} = 4\hat{i} - 2\hat{j} - 5\hat{k}$ into spherical coordinates **(4)**

b) If a scalar variable is $\phi = Ax^2yz^3$ then find the value of

i) $\nabla\phi$ and

ii) $\nabla.(\nabla\phi)$ **(2 × 2=4)**

c) Prove the stokes theorem $\oint A.dl = \int_s (\nabla \times A).ds$ Also write the significance it. **(8)**

OR

1. a) What is the significance of line integral? Find the line integral of a vector $\vec{A} = x^2\hat{a}_x + xy\,\hat{a}_y$ from point p(0,1,0) to q(2,1,1) **(8)**

b) A vector in cylindrical coordinate is given by $\vec{A} = r\cos\phi\ a_r - r\sin\phi\ a_\phi$ then find the value of closed surface integral $\oint A\,ds$ over the surface of the box bounded by planes z=0 and z=1, $\phi = 0$ and $\phi = \frac{\pi}{2}$ and the cylinder r = 9 **(8)**

Unit - II

2. a) State the Coloumb's law in vector form. using it find the coloumb force between to point charge

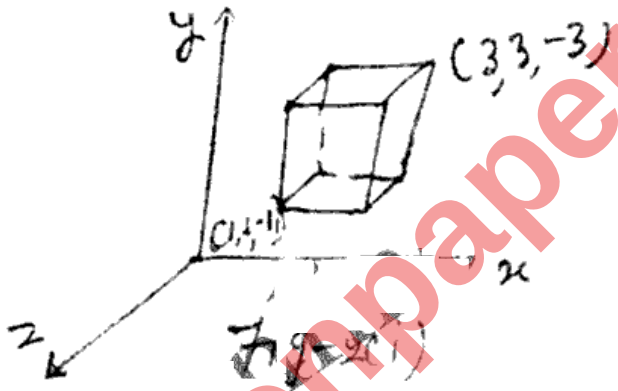
$q_1 = 10\mu c$ at $(2, \frac{\pi}{2}, 2)$ and

$q_2 = -5\mu c$ at $(0, \frac{\pi}{2}, 4)$ **(6)**

b) Write the limitations of Coloumb's law **(2)**

c) prove that the energy density in electric field is given by

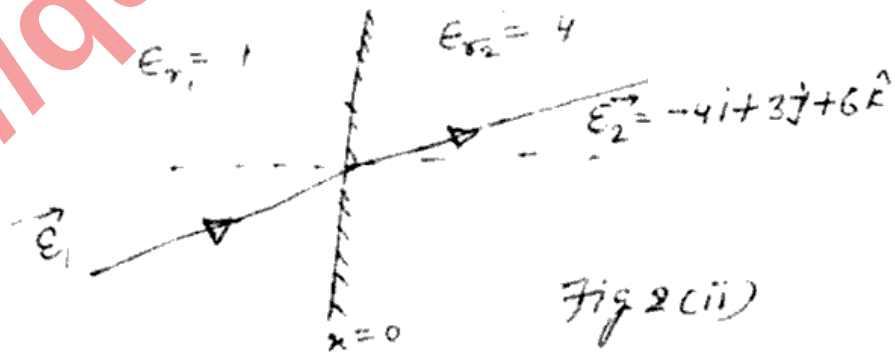
$W_e = \frac{1}{2} D.E$ if the electric field is given by $\vec{\varepsilon} = xi + 2j + 2\hat{k}$ then find the total energy stored in a cube of arm 2 meter placed as in fig-2(i)



(8)

OR

2. a) State the boundary condition for electric field using boundary condition find the incident field $\vec{\varepsilon}_1$ in fig-2(ii)



(8)

Assume the boundary interface is charge free

b) State Laplace-equation and using it find the capacitance for

i) Concentric spherical capacitor

ii) Cylindrical capacitor (2×4=8)

Unit - III

3. a) Prove the maxwell's third & fourth equation for static magnetic field (2×4=8)

b) If the magnetic vector potential in spherical coordinate is given by $\vec{A}=10\sin\theta\, l_\phi$ then find the magnetic flux density(B) at $(2,\pi,0)$ *and at* $(0,\pi/2,0)$ (8)

OR

3. a) If the magnetic field intensity in free space is given by

$$\vec{H}=\frac{20}{x^2+y^2}(xa_x+ya_y)\ \ A/m.$$

Then show that

i) $\nabla.B=0$ *and*

ii) Find the current density J (8)

b) Prove that at the interface of two magnetic media of permeability $\mu_1, 2\mu_2$, the

i) Normal flux continue and

ii) Tangential component of magnetic field intensity is discontinue (8)

Unit - IV

4. a) For a lossy medium having $\mu_r=1$, $E_r=24$ *and* $\sigma=20$ S/m calculate attenuation constant phase constant and intrinsic impedance at a frequency f=10GHz (8)

b) Find the expression for attenuation constant α and phase constant β for

i) Good dielectric

ii) Perfect insulator

iii) Good conductor and

iv) Perfect conductor (4×2=8)

OR

4. a) Modify the maxwells equation (8)

i) $\nabla\times E=0$ and

ii) $\nabla\times H=J$

for a time varying field. Also explain the concept of displacement current

b) If the electric field of an EM wave propagation in X-direction is given by $\varepsilon_y = 1000\cos\{10^9 t - \beta x\}$ Then find its

i) Magnetic field

ii) Energy flow per unit area per second (8)

Unit - V

5. a) If the current density in a wire is given by $j_z = 20 \sin \omega t \ \hat{j}_z$ then find the retarted magnetic potential at a distance r from it (4)

b) State the radiation conditions and find the radiated power from a current element of length 10m at a frequency whose wavelength is 40m (4)

c) Explain the shielding and grounding method for avoid interference. (8)

OR

5. Write short notes on any **two** :

i) EMI coupling modes

ii) EMI testing

iii) EMI standard

iv) Methods for achieve EMC (2×8=16)