

4E4133

Roll No. _____

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B. Tech. IV-Sem. (Main / Back) Exam; April-May 2017
Electronics & Communication Engg.
4EC4A Electromagnetic Field Theory

Time : 3 Hours

Maximum Marks : 80
 Min. Passing Marks : 24

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. Use of following supporting materials is permitted during examination. (Mentioned in form No. 205)

1. NIL _____ 2. NIL _____

UNIT - I

- 1 If the electric field intensity is given by $\vec{E} = 30i + 2xy^2\hat{j} + 5xz^2\hat{k}$ then find
- The work done in moving $20\mu\text{c}$ from origin to (1,2,0) in this field.
 - The work done in a circular path of radius 2 meter in xy plane for unit positive charge
 - The electric field in cylindrical co-ordinate system.

4+4+8=16

OR

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- 1 (a) If the charge density is given by $\rho(x,y,z) = \frac{20}{x} + y^2z$ then find the total charge in a cube placed in first quadrant as shown in fig-1.

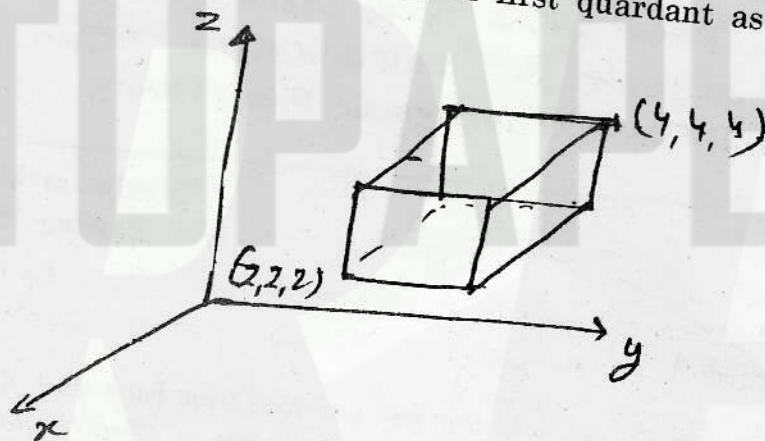


Fig. 1

- (b) Explain the use of following w.r. to field theory. 10
- (i) Curl
 - (ii) Divergence
 - (iii) Stokes theorem
 - (iv) Divergence theorem.

UNIT - II 6

- 2 Prove that :
- (i) Equipotential surface is normal to electric field intensity.
 - (ii) Normal component of electric flux density passes without any change at the interface when charge density at interface is zero.
 - (iii) $\nabla \cdot D = \rho_v$
 - (iv) $\nabla \times E = 0$ in static field.

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OR

4×4=16

2

[P.T.O.

- 2 (a) Find the electric field intensity at any point due to a charge density

$$\rho(x, y, z) = 20x^2y^2z \text{ C/m}^3$$

Also find the electric field at

(i) Origin and

(ii) (0, 0, 2)

Assume the medium has relative permittivity $\epsilon_r = 4$

- (b) Find the electrical energy stored in a sphere of radius = 2 meter around a point charge of $10 \mu\text{C}$ placed at the centre of this sphere. Assume the relative permittivity is $\epsilon_r = 2$.

10

UNIT - III

6

- 3 (a) Find the magnetic field intensity in medium-2 (fig.2)

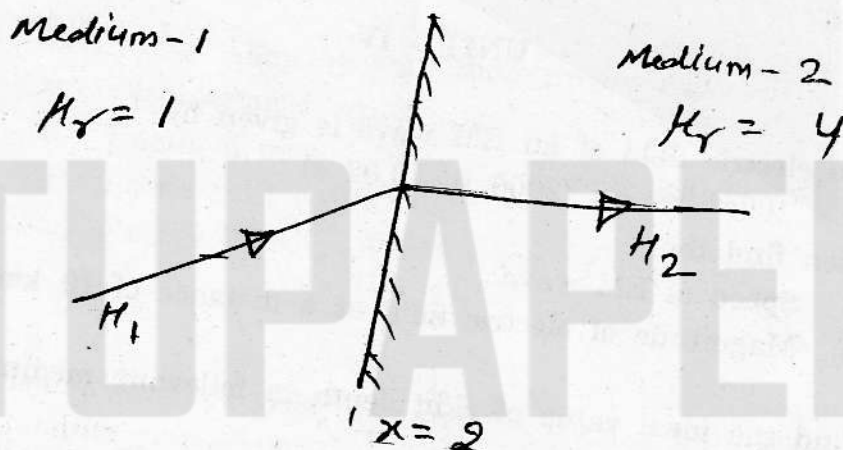


Fig. 2

Assume

$\mu_1 = 20\hat{i} + y\hat{j} + a\hat{k}$ and current density at interface is zero.

(b) Prove that

(i) $\nabla \cdot B = 0$

(ii) $\vec{B} = \nabla \times \vec{A}$.

4+4=8

OR

3 (a) Find the analogous relation of following in magnetic field.

(i) $V(x, y, z) = \frac{1}{4\pi\epsilon_0} \int \frac{\rho(x, y, z) dv}{r}$

(ii) $\nabla^2 V = \frac{\rho}{\epsilon}$

(b) A current loop (2×4) cm², carrying 2 ampere current is placed in yz plane. Find torque on it if the magnetic field at that region is given

$\vec{B} = 200\hat{j} + 10\hat{k}$

4+4=8

UNIT - IV

8

4 (a) The electric field of an EM wave is given by

$E_x = 100e^{-0.02z} \sin(2000t - 0.02z)$

Then find the

(i) Speed of EM wave

(ii) Magnitude of electric field at a distance of 10 km

4×2=8

(b) Find the ideal value of skin depth in following medium

(i) Perfect vacuum

(ii) Perfect conductor at DC

(iii) Perfect conductor at f = 10 GHz

(iv) Conductor with conductivity $\sigma = 10^6 \text{ S}\Omega$ at f = 10⁹ Hz

4×2=8

OR

- 4 (a) A wave is incident from medium 1 to medium 2 then find its (fig 3)

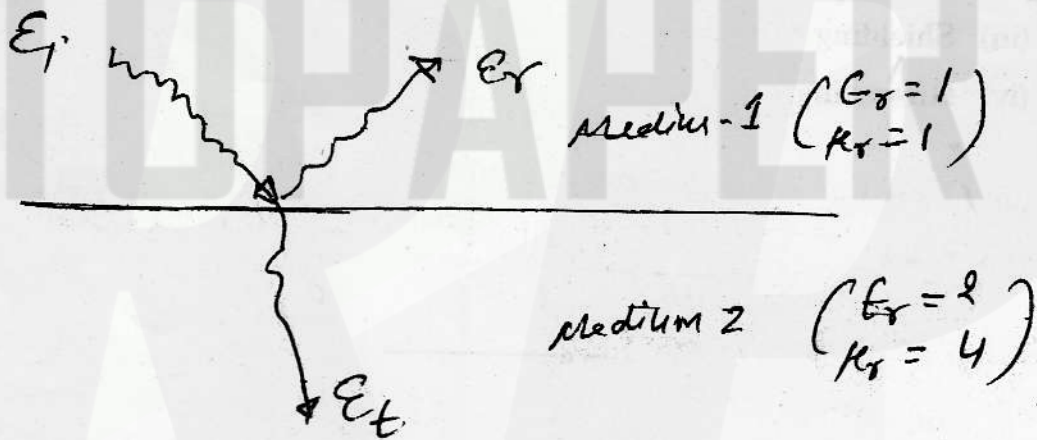


Fig. 3

- (i) reflected power
(ii) transmitted power.
- (b) Define the following with their proper expressions :
- (i) Displacement vector
(ii) Depth of penetration
(iii) Phase shift coefficient
(iv) Energy density of EM wave.

4+4=8

4×2=8

UNIT - V

- 5 Find the radiation resistance of dipole antenna.

16

OR

5 Write short notes on any two :

- (i) EMI testing
- (ii) EMC
- (iii) Shielding
- (iv) Grounding.

8×2=16