

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0324

Roll No.

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B. Tech.

(Semester-III) Theory Examination, 2011-12

ELECTROMAGNETIC FIELD THEORY

Time : 3 Hours]

[Total Marks : 100

Note : Attempt questions from each Section as per directions.

Section-A

1. Write short answers : $2 \times 10 = 20$
 - (a) Given $\vec{A} = 2a_x + 4a_y - 3a_z$ and $\vec{B} = a_x - a_y$, find $A \cdot B$.
 - (b) Show that :
 $\vec{A} = 4a_x - 2a_y - a_z$ and $\vec{B} = a_x + 4a_y - 4a_z$ are perpendicular.
 - (c) Define line charge.
 - (d) Define Gauss' law.
 - (e) Define Ampere's law.
 - (f) Explain Stoke's theorem.
 - (g) Define conduction current.

- (h) For a given medium the characteristic impedance is $150 \angle 30^\circ \Omega$. The loss tangent of this medium is _____.
- (i) Define reflection coefficient.
- (j) Define standing wave ratio.

Section-B

2. Attempt *all* parts : 6×5=30

- (a) State and explain the Divergence theorem.
Given a vector $\vec{A} = 3xa_x + ya_y + 5za_z$, find the curl of \vec{A} .
- (b) A charge $Q_1 = -10\text{nC}$ is at the origin in free space. If the x -component of E is to be zero, at the point $(3, 1, 1)$, what charge Q_2 should be kept at the point $(2, 0, 0)$?
- (c) State and explain Biot-Savart law.
If the magnetic field $\vec{H} = 100 \sin \theta a_\theta$ A/m in spherical coordinates, determine J at $(10, \pi/2, 0)$.
- (d) Given $E = 10 \sin(\omega t - \beta z) a_y$ V/m in free space, determine \vec{D} , \vec{B} , \vec{H} .
- (e) A lossless transmission line of length 100 m has an inductance of $28 \mu\text{H}$ and a capacitance of 20 nF. Find :
- (i) Propagation velocity
 - (ii) Phase constant at an operating frequency of 100 kHz.
 - (iii) Characteristic impedance of the line.

Section-C

3. Attempt any five parts : $10 \times 5 = 50$

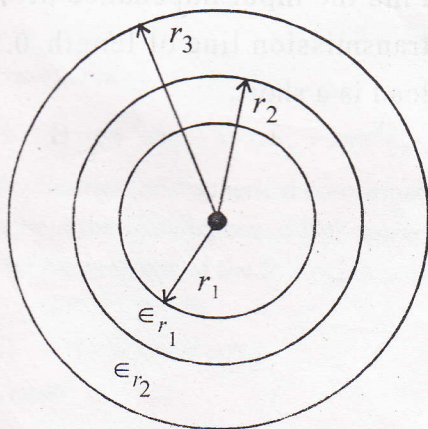
(a) Three equal point charges of $2 \mu\text{C}$ are in free space at $(0, 0, 0)$, $(2, 0, 0)$ and $(0, 2, 0)$, respectively. Find net force on $Q_4 = 5 \mu\text{C}$ at $(2, 2, 0)$.

(b) Define electric flux density.

A point charge $Q = 10\text{nC}$ is at the origin in free space. Find the electric field at $\rho(1, 0, 1)$. Also find the electric flux density at ρ .

(c) Define polarization.

The cable shown in figure below is 10 km long. If $r_1 = 10 \text{ mm}$, $r_2 = 15 \text{ mm}$, $r_3 = 20 \text{ mm}$, $\epsilon_{r1} = 2.0$, $\epsilon_{r2} = 4.0$, find the capacitance of the cable.



- (d) Two homogenous, linear and isotropic media have an interface at $x=0$. $x < 0$ describe medium 1 and $x > 0$ describe medium 2, $\mu_{r1} = 12$ and $\mu_{r2} = 5$. The magnetic field in medium 1 is $150a_x - 400a_y + 250a_z$ A/m. Determine:
- (i) Magnetic field in medium 2.
 - (ii) Magnetic flux density in medium 1 and 2.
- (e) State and explain the Maxwell's equation in differential and integral form.
- (f) Derive the relation between E and H in uniform plane wave.
- (g) Define different types of losses in transmission line.
- (h) Find the input impedance of 75Ω lossless transmission line of length 0.1λ when the load is a short.

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