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# 328456(28)

## B. E. (Fourth Semester) Examination, April-May 2020

**(New Scheme)**

**(Et&T Branch)**

## ELECTROMAGNETIC FIELDS & TRANSMISSION LINES

***Time Allowed : Three hours***

***Maximum Marks : 80***

***Minimum Pass Marks : 28***

***Note :*** *Attempt all questions. Part (a) from each question is compulsory. Attempt any two parts from parts (b), (c) and (d).*

### Unit-I

**1.** (a) Express the Laplacian of a scalar $V$ in cylindrical and spherical coordinate system. 2

(b) A close surface is defined in spherical coordinates by

$3 < r < 5,\ 0{\cdot}1\,\pi < \theta < 0{\cdot}3\,\pi,\ \ 1{\cdot}2\,\pi < \phi < 1{\cdot}6\,\pi$.

(i) Find the volume enclosed

(ii) Find the distance from

$P_1\,(r = 3, \theta = 0{\cdot}1\,\pi, \phi = 1{\cdot}2\,\pi)$ to

$P_2\,(r = 5, \theta = 0{\cdot}3\,\pi, \phi = 1{\cdot}6\,\pi)$

(iii) Find the total surface area. 7

(c) Derive the expression for Electric Field Strength due to infinite line charge. 7

(d) Eight 25-nC point charges in free space are located symmetrically on a circle of radius 0.2 m centered at the origin in the $z = 0$, plane.

(i) At what point on the $z$ axis is $|\bar{E}|$ a maximum?

(ii) What is $|\bar{E}|_{max}$? 7

## Unit-II

**2.** (a) Write the applications of Poisson's and Laplaces's equation. 2





(b) In free space, a line charge $\varrho_L = 80\ \text{nC/m}$ lies along the entire $z$ axis, while point charges 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). 7

(c) Explain the Energy density in the Electrostatic fields. 7

(d) State and prove the Uniqueness theorem. 7

## Unit-III

**3.** (a) What is Stoke's theorem? 2

(b) If $\bar{A} = 10\ \varrho^{1{\cdot}5}\ \hat{a}_z$ wb/m in free space, find 7

(i) $\bar{H}$

(ii) $\bar{J}$

(iii) Show that $\oint \bar{H} \cdot \bar{d}_L = I$ for a circular path with $\varrho = 1$. 7

(c) State and prove Ampere's Circuital Law? 7

(d) An isotropic material has a magnetic susceptibility of 3 and the magnetic flux density

$\bar{B} = 10\, y\, \hat{a}_x$ m wb/m$^2$. Determine $\mu_r, \mu, \bar{J}_b$, $\bar{J}, \bar{M}$ and $\bar{H}$. 7

## Unit-IV

**4.** (a) Write the Maxwell's equation in phasor form. 2

(b) Explain and prove the Boundary conditions on $\bar{E}, \bar{D}, \bar{H}$ and $\bar{B}$. 7

(c) When the amplitude of the magnetic field in a plane wave is 2 A/m,

(i) Determine the magnitude of the Electric field for the plane wave in free space

(ii) Determine the magnitude of the electric field when the wave propagates in a medium which is characterised by $\sigma = 0$, $\mu = \mu_0$ and $\varepsilon = 4\,\varepsilon_0$. 7

(d) State and prove Poynting's theorem. 7

## Unit-V

**5.** (a) What are Reflection coefficient? 2





(b) Prove that the input impedance of a transmission line terminated with any load impedance $Z_R$ is given by $Z_S = Z_O \left[ \dfrac{Z_R + Z_O \tanh P\ell}{Z_O + Z_R \tanh P\ell} \right]$ 7

(c) A transmission live has series inductance of 0·56 millihenry and capacitance of 0·1 microfarad per km. If the losses due to conductor resistance and insulation leakage are negligible, calculate the (i) characteristics Impedance (ii) The phase velocity. 7

(d) Explain the single stub matching? 7