Total No. of Questions : 8]

SEAT No. :

P2381

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T.E. (Electronics & Telecommunication)

ELECTROMAGNETICS AND TRANSMISSION LINES

(2012 Pattern) (304184) (Semester - I) (End Semester)

Time : 3 Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) *Answers to the two sections should be written in separate answer books.*
2) *Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, Q7 or Q8.*
3) *Neat diagrams must be drawn wherever necessary.*
4) *Figures to the right indicate full marks.*
5) *Use of calculator is allowed.*
6) *Assume suitable data if necessary.*

Q1) a) Derive the expression for electric field intensity $\overline{E}$ at a point 'P' due to infinite line charge with uniform line charge density 'ρ_L'. **[6]**

b) Derive Laplace and Poisson equations for electrostatics & hence state physical significance of Laplace & Poisson equations. **[6]**

c) A current sheet $\overline{k} = 9\overline{a}_y$ A/m is located at $z = 0$. The region 1 which is at $z < 0$ has $\mu_{r1} = 4$ and region 2 which is at $z > 0$ has $\mu_{r2} = 3$.

Given : $\overline{H}_2 = 14.5\overline{a}_x + 8\overline{a}_z$ A / m Find $\overline{H}_1$ **[8]**

OR

Q2) a) Derive the expression for the capacitance of spherical plate capacitor. **[6]**

b) Derive expression for Biot & Savart law using magnetic vector potential. **[6]**

c) $\overline{D} = \dfrac{5x^3}{2}\hat{a}x$ c/m^2. Prove divergence theorem for a volume of cube of side 1m. Centered at origin & edges parallel to the axis. **[8]**

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Q3) a) Define displacement current and displacement current density & hence show that **[8]**

$\nabla \times \mathrm{H} = J_c + J_d$

Where $\mathrm{J_c} \rightarrow$ conduction current density

$\mathrm{J_d} \rightarrow$ Displacement current density

b) Select values of K such that each of the following pairs of fields satisfies Maxwell's equation. **[8]**

i) $\bar{\mathrm{E}} = (\mathrm{K}x - 100t)\bar{a}_y \ \mathrm{V}/m$

$\bar{\mathrm{H}} = (x + 20t)\bar{a}_z \ \mathrm{A}/m$

$\mu = 0.25 H/m \quad \varepsilon = 0.01 F/m$

ii) $\bar{\mathrm{D}} = 5x\,\hat{a}_x - 2y\,\hat{a}_y + Kz\hat{a}_z \ \mu c/m^2$

$\bar{\mathrm{B}} = 2\bar{a}_y \ m\mathrm{T}$

$\mu = \mu_0 \quad \varepsilon = \varepsilon_0$

OR

Q4) a) What is mean by uniform plane wave, obtain the wave equation travelling in free space in terms of E. **[8]**

b) Derive Maxwell's equations in differential and integral form for time varying and free space. **[8]**

Q5) a) Derive the expression for characteristic impedance (Z_0) and propagation constant (r) in terms of primary constants of transmission line. **[8]**

b) A cable has an attenuation of 3.5dB/Km and a phase constant of 0.28 rad/km. If 3V is applied to the sending end then what will be the voltage at point 10 km down the line when line is terminated with Z_0. **[8]**

OR

Q6) a) Explain the phenomenon of reflection of transmission line and hence define reflection coefficient. **[6]**

b) A transmission line cable has following primary constants. **[10]**

$R = 11\,\Omega$/km, $G = 0.8\ \mu$mho / km

$L = 0.00367$ H/Km $C = 8.35$ nF/km

At a signal of 1 kHz calculate

i) Characteristic impedance Z_0

ii) Attenuation constant (α) in Np/Km

iii) Phase constant (β) in radians / Km

iv) Wavelength (λ) in Km

v) Velocity of signal in Km/sec.

Q7) a) What is the impedance matching? Explain necessity of it, what is stub matching? Explain the single stub matching with its merits and demerits. **[9]**

b) Explain standing wave and why they generate? Derive the relation between the SWR and magnitude of reflection coefficient? **[9]**

OR

Q8) a) What do you mean by distortionless line. Derive expression for characteristic impedance and propagation constant for distortionless line. **[8]**

b) The VSWR on a lossless line is found to be '5' and successive voltage minima are 40 cm a part.The first voltage minima is observed to be 15cm from load. The length of a line is 160cm and characteristic impedance is $300\,\Omega$. Using Smith chart find load impedance, sending end impedance. **[10]**

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