Total No. of Questions : 8]

SEAT No. :

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[6583]-100

T.E. (Electronics & Telecommunication)

ELECTROMAGNETIC FIELD THEORY

(2019 Pattern) (Semester - V) (304182)

Time : 2½ Hours] *[Max. Marks : 70*

Instructions to the candidates :

1) ***Answer Q1 or Q2, Q3 or Q4, Q5 or Q6, and Q7 or Q8.***
2) ***Figures to the right indicate full marks.***
3) ***Assume the suitable data, if necessary.***

Q1) a) Derive electrostatic boundary condition at an interface between conductor and free space. **[8]**

b) A current element $I_1\Delta L_1 = 10^{-5}\bar{a}_z A.\ m$ located at (1, 0, 0) and $I_2\Delta L_2 = 10^{-5}(0.6\bar{a}_x - 2\bar{a}_y + 3\bar{a}_z) A\ m$ located at (–1,0,0) in free space. Find the vector force exerted on $I_2\Delta L_2$ *by* $I_1\Delta L_1$. **[8]**

OR

Q2) a) Derive an expression of parallel plate capacitor for more than one dielectric interface. **[8]**

b) A boundary exits at z = 0 between two dielectrics $\varepsilon_{r1} = 2.5$ in $z < 0$ and $\varepsilon_{r2} = 4$ in $z > 0$. The field region of ε_{r1} is $\bar{E} = -30\bar{a}_x + 50\bar{a}_y + 70\bar{a}_z$ V/m. Find. **[8]**

i) Normal and tangential component of E_1 and D_2

ii) Angle between E_1 & normal to surface and Angle between E_2 & normal to surface

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Q3) a) State Maxwell's equation for static and time varying electric and magnetic fields in both integral and differential form. **[9]**

b) In a region where $\varepsilon_r = \mu_r = 1$ and $\sigma = 0$. Find electric and magnetic field intensity.If

$$\bar{A} = 10^{-3}\, y \cos 3\times10^{8} t \cos z \bar{a}_z \frac{wb}{m} \quad and \quad \bar{V} = 3\times10^{5}\, y \sin 3\times10^{8} t \sin z V.$$

[9]

OR

Q4) a) State pointing vector. Derive the expression for pointing vector. What is its significance? **[9]**

b) The electric field $\bar{E} = 200 \sin wt\ \bar{a}_z\ V/m$ exit at a certain point in the lossy dielectric **[9]**

i) At what frequency will the conduction current and displacement current densities have equal magnitude?

ii) At this frequency find the instantaneous displacement current density

iii) What is the phase angle between these two.

Assume $\mu = 4\pi \times 10^{-7}\ H/m$, $\varepsilon = 8.854 \times 10^{-12}$ & $\sigma = 2 \times 10^{-8}\ S/m$.

Q5) a) For electromagnetic wave, derive the expression for velocity and wavelength in terms of conductivity of good conductor. **[9]**

b) A plane wave propagation through a medium $\varepsilon_r = 8$, $\mu_r = 2$ has $\bar{E} = 0.5 \sin(10^6 t - \beta z)\, \bar{a}_x\ V/m$. Determine **[9]**

i) β

ii) η

iii) Velocity and Magnetic field intensity at t = 1 sec

OR

Q6) a) Explain the concept of uniform plane wave. Also explain polarization of uniform plane wave. **[9]**

b) Determine the amplitude of the reflected and transmitted E & H at the interface of two media with medium-1 $\varepsilon_r = 8.5$, $\mu_r = 1$ and $\sigma = 0$ & medium-2 is free space. Assume normal incidence and the amplitude of $\bar{E}$ in medium-1 at the interface is 1.5 V/m. **[9]**

Q7) a) A transmission line has a characteristic impedance of 300Ω and terminated in load $150 + j\,150\Omega$. Find the following using smith chart. **[10]**

i) VSWR

ii) reflection coefficient

iii) i/p impedance at distance 0.1λ from the load

iv) i/p admittance at distance 0.1λ from the load &

v) position of first minima and maxima form the load.

b) What is mean by dissipationless line? Derive an expression for input impedance of dissipationless line. **[8]**

OR

Q8) a) State primary and secondary constants and derive the relationship between primary and secondary constant. **[10]**

b) If attenuation constant is 18×10^{-3} N/m, Velocity of propagation V is 1.8×10^{8} m/sec and characteristic impedance is 60Ω. Find out the primary line constant of such distortionless line at a frequency of 100Mhz. **[8]**

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