Total No. of Questions : 8]

SEAT No. : ____

PF-4958

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T.E. (E&TC)
ELECTROMAGNETIC FIELD THEORY
(2019 Pattern) (Semester - V) (304182)

Time : 2½ Hours] ***[Max. Marks : 70***

Instructions to the candidates :

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

Q1) a) Derive the boundary conditions at an interface between two magnetic, media (having permeability μ_1 and μ_2) in terms of magnetic field intensity and magnetic flux density. **[8]**

b) i) Explain the concept of polarization in dielectrics.

ii) Solve the numerical given below:

A boundary exists at z = 0 between two dielectrics ε_{r1} = 2.5 in region z < 0. and ε_{r2} = 4 in the region z > 0. Given the field in the region of ε_{r1} is given by: $E = -30\ \hat{a}_x + 50\ \hat{a}_y + 70\ \hat{a}_z$ V/m.

Find : I) Normal and Tangential component of E_1.

II) Normal and Tangential component of D_2.

[10]

OR

Q2) a) Derive the boundary conditions at an interface between two separating dielectric (ε_{r1}) and dielectric (ε_{r2}) in terms of electric field intensity and electric flux density. **[8]**

b) i) For a homogeneous medium, write down the Poisson's equation and Laplace equation.

ii) Explain the general procedure to solve Poisson's or Laplace equation.

[10]

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Q3) a) State Poynting theorem. Derive the expression for Poynting vector. Calculate ε_r and η for a wave E in a nonmagnetic mediurn ($\mu = \mu_0$, α=0):

$E = 4 \sin (2\pi * 10^7 t - 0.8x) a_z$ V/m **[9]**

b) Explain the concept of concept of retarded magnetic vector potential. **[8]**

OR

Q4) a) Derive Maxwell's equations (time varying field) in differential and integral form. **[9]**

b) Explain continuity equation and explain the interpretation of the same. **[8]**

Q5) a) Draw neat diagrams and obtain the equations for incident wave, reflected wave and transmitted wave for "reflection of a plane wave at normal incidence". Write the equations for reflection coefficient Γ and transmission coefficient τ. **[9]**

b) Explain the behavior of plane waves in lossy dielectric medium. Write the equations for attenuation constant, phase constant and phase velocity for lossy dielectric. **[9]**

OR

Q6) a) A plane wave propagating through a medium with $\in r = 8$, $\mu r = 2$ has

$$E = 0.5e^{-\frac{z}{3}} \sin\left(10^8 t - \beta z\right) a_x \text{ V/m}$$

Determine:

i) β

ii) intrinsic impedance

iii) wave velocity

iv) H field **[9]**

b) What is uniform plane wave? In relation with uniform plane wave explain the terms : **[9]**

i) Propagation constant

ii) Attenuation constant

iii) Phase velocity.

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Q7) a) A 50 Ω lossy line has secondary line constants α = 0.04 dB/m and β = 2.5 rad/m at 60 MHz. Calculate the primary line constants R. L, G and C of the line. **[9]**

b) A 2 m transmission line operating at $\omega = 10^6$ rad/s has characteristic impedance Zin = 60.25 + j 38.79 Ω is terminated by a load of 20 + j50 Ω. Given, α = 8 dB/m and β = 1 rad/m, calculate:

i) α in Np/m

ii) γ in per m

iii) sending current if the line is connected to a source of 10 V, Zg = 40 Ω **[8]**

OR

Q8) a) A lossless transmission line with Z0 = 50 Ω, is terminated with a load Z_L = 120 Ω and operates at 2 MHz. If the length of transmission line is $\lambda/6$, calculate the reflection coefficient, standing wave ratio and Zin at the generator. **[9]**

b) Determine the characteristic impedance, propagation constant and phase velocity of a telephone line with following primary line constants at a frequency of I KHz:

R = 30 Ω/km, L = 100 mH/km, G=0 and C = 20 μF/km. **[8]**

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