(2064)

14669

B. Tech 4th Semester Examination

Electromagnetic Field Theory (O.S.)

EE-4003

Time : 3 Hours **Max. Marks : 100**

The candidates shall limit their answers precisely within the answer-book (40 pages) issued to them and no supplementary/continuation sheet will be issued.

Note : Attempt five questions in all, selecting one question from each of the section A, B, C, and D and all the subparts of the question in Section E. All questions carry equal marks and assume missing data if any suitably.

SECTION - A

1. (a) Define divergence and curl of a vector. (4)

   (b) State and derive Gauss's law for a spherical surface enclosing a charge Q. (8)

   (c) Two point charges Q_1=2 nC and Q_2=4nC are located at (1, 1, 1) and (1, 0, 0), respectively. Determine the potential at P(1, 1, 0) due to the point charge. (8)

2. (a) State the importance of unit vector. (4)

   (b) State and prove Stoke's theorem (8)

   (c) State and explain Coulomb's law (8)

SECTION - B

3. (a) State Maxwell's equations in their general integral and differential form and also write their expression for static fields. (8)

(b) Define skin effect and depth of penetration. (4)

(c) The parallel plates in a capacitor have an area of 4×10^{-4} m^2 and are separated by 0.4 cm. A voltage of 10 $\sin^3 t$ volts is applied to the capacitor. Find the displacement current when the dielectric material between the plates has a relative permittivity of 4. (8)

4. (a) State and prove Poisson's equation and state its applications. (10)

(b) State and prove relation between current density and volume charge density. (10)

SECTION - C

5. (a) State Poynting theorem and define complex Poynting vector and their application. (6)

(b) State primary and secondary constants of a transmission line. (6)

(c) A lossless transmission line used in a TV receiver has a capacitance of 50 pF/m and an inductance of 200 nH/m. Find the characteristic impedance for sections of a line 10 meter long and 500 meter long. (8)

6. (a) Define uniform plane wave and state propagation of EM waves in free space. (6)

(b) What are stubs and discuss their utility in transmission lines. (4)

(c) When the amplitude of a magnetic field in a plane wave is 2 A/m, (a) determine the magnitude of the electric field for the plane wave in free space, (b) determine the magnitude of the electric field when the wave propagates in a medium which is characterized by $\sigma = 0$, $\mu = \mu_0$ and $\epsilon = 4\epsilon_0$ (10)

SECTION - D

7. (a) State and prove wave equations for a conducting medium. (10)

   (b) State and explain propagation characteristics of EM waves in conducting medium. (10)

8. (a) Define transmission lines. State their types and applications. (10)

   (b) State the secondary constants of a transmission line. Write their expressions for lossless transmission lines. (10)

SECTION - E

9. Choose and write the correct answer. Avoid overwriting.

   (i) If the magnetic flux of 8 mwb changes to 10 mwb in 1.0 seconds, the rate of flux is

   (a) 1.0 mwb/s (b) 2.0 mwb/s

   (c) 0 mwb/s (d) 18 mwb/s

   (ii) If a magnetic flux of 4μwb passes through an area of 5×10^{-4} m^2, the flux density is

   (a) 8 mT (b) 80 mT

   (c) 0.8 mT (d) 0.08 mT

   (iii) Magnetization satisfies the relation

   (a) $\nabla \times M = J_b$ (b) $\nabla \times M = J$

   (c) $\nabla \times M = 0$ (d) $\nabla \times M = I_b$

   (iv) The distortion less condition for a transmission line is

   (a) LG = RC (b) LR = GC

   (c) GR = LC (d) LC = Q

(v) The velocity in an EM wave in a medium whose $\epsilon_r = 2, \mu_r = 2$ is

(a) 3×10^8 m/s (b) $3\times l0^8$cm/s

(c) 1.5×10^8 m/s (d) 1.5×10^8 cm/s

(vi) The current density in silver $\left(\sigma = 61.7 \times 10^6 \frac{\text{ohm}}{\text{m}}\right)$ when the electric field is 1.0 V/m is

(a) 61.7×10^6A/m^2 (b) 6.17×10^6A/m^2

(c) $617 \times \frac{10^6 A}{m^2}$ (d) $0.617 \times \frac{10^6 A}{m^2}$

(vii) If the electric susceptibility of a medium is 3, the permeability is

(a) 4 F/m (b) 35.416×10^{-12} F/m

(c) 2 F/m (d) 8 F/m

(viii) The medium has $\epsilon_r = 25, \mu_r = 1$. The velocity of the wave in this medium is

(a) 0.6×10^8 m/s (b) 6×10^8 m/s

(c) 0.06×10^8m/s (d) 0.6×10^8cm/s

(ix) For a plane travelling wave if the electric energy density is 10 mJ/m^3, the magnetic energy density is

(a) 10mJ/m^3 (b) 1.0mJ/m^3

(c) zero (d) 100 mJ/m^3

(x) If E= 10 V/m in free space , D is

(a) zero (b) $10 \epsilon_0$ C/m

(c) $\frac{10}{\epsilon_0}$ C/m^2 (d) $10 \epsilon_0$ C/m^2

(2×10=20)