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(2063)

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B. Tech 4th Semester Examination

Electromagnetic Field Theory

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) Establish relationship between cartesian and cylindrical coordinate systems. **(6)**

   (b) Define potential. Derive the expression potential at a point due to a point charge. **(6)**

   (c) In free space let Q_1 be 10 nC be at P_1(0,-4,0) and Q_2 be 20 nC be at P_2(0,0,4). Find (a) E at the (8) origin, (b) Where should a 30 nC point charge be located so that E=0 at the origin. **(8)**

2. (a) Given $V = x^2y + xy^2 + xz^2$, (a) find the gradient of V and (b) evaluate it at (1, -1, 3). **(6)**

   (b) Derive the expression for electric field strength due to infinite line charge. **(8)**

   (c) Derive the expression for energy stored in a capacitor. **(6)**

SECTION - B

3. (a) Name different types of media from EMFT point of view. State Maxwell's equations in their phasor form. **(8)**

   (b) Define electric displacement and displacement density. **(4)**

   (c) A toroid has air core and has a cross-sectional area of 10 mm^2. It has 1000 turns and its mean radius is 10 mm. Find its inductance. **(8)**

4. (a) State and prove Laplace's equation and write its applications. **(10)**

   (b) State and prove Ampere's force law. **(10)**

SECTION - C

5. (a) Explain conductors and dielectric from current density and frequency point of view with their field of application. **(8)**

   (b) Define wave velocity, phase shift constant, wavelength and phase velocity of wave. **(6)**

   (c) The wavelength of an x directed plane wave in a lossless medium is 0.25 m and the velocity of propagation is 1.5 x $l0^{l0}$cm/s. The wave has z directed electric field with amplitude equal to 10V m. Find the frequency and relative permittivity of the medium. The medium has $\mu = \mu_0$. **(8)**

6. (a) Derive the wave propagation characteristic of an EM wave in good conductors. **(8)**

   (b) State the equation of continuity and its applications. **(6)**

   (c) Calculate the capacitance of an isolated sphere of radius 1 cm. **(4)**

SECTION - D

7. (a) State and explain propagation characteristics of EM waves in free space. **(10)**

   (b) State polarization of a wave and explain different types of polarization. **(10)**

8. (a) State the primary constants of a transmission line. Write their expressions for parallel wires. **(10)**

   (b) State and explain the various losses occurring in transmission lines. **(10)**

SECTION - E

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

   i. When a magnetic flux cuts across 200 turns at the rate of 2 wb/s, the induced voltage is

   (a) 400 V (b) 100 V

   (c) 600 V (d) 0 V

   ii. Ampere's law is applicable for

   (a) open path only

   (b) closed path only

   (c) either open or closed path only

   (d) square path only

   iii. A transmission line whose Z_0=75 Ohm is terminated by 75 Ohm. Its input impedance is

   (a) 75 Ohm (b) 150 Ohm

   (c) 375 Ohm (d) 300 Ohm

   iv. The intrinsic impedance of free space is

   (a) 120 π ohm (b) 300 ohm

   (c) 75 ohm (d) 73 ohm

v. If the magnitude of magnetic flux density in free space is $4\pi \times 10^{-7}$ wb/m^2, the magnetic field strength is

(a) 1 A/m (b) $4\pi \times 10^{-7}$ A/m

(c) 1 wb/m (d) $4\pi \times 10^{-7}$ wb/m

vi. The charge stored in a capacitor when a constant current of 2 μ A flows for 20 seconds is

(a) 40 μC (b) 10 μC

(c) 400 μC (d) 200 μC

vii. The wavelength of a sine wave with propagation constant = 0.1π + j0.2 is

(a) 10 m (b) 20m

(c) 30 m (d) 25 m

viii. The magnitude of H of a plane wave in a medium is 5 A/m. The medium constants are $\in_r = 4, \mu_r = 1$. The average power is

(a) 2354 w/m^2 (b) 23.54 w/m^2

(c) 235.4 w/m^2 (d) 2.354 w/m^2

ix. At low frequencies, Z_0 of the transmission line is

(a) $\sqrt{\frac{R}{G}}$ ohm (b) $\sqrt{\frac{G}{R}}$

(c) $\sqrt{\frac{L}{C}}$ (d) $\sqrt{\frac{C}{L}}$

x. If Z, = 100 + j200 and Z_0 = 50 ohm, the normalized impedance is

(a) 1 + J2 (b) 2 + J4

(c) $\sqrt{20}$ (d) 6 **(2×10)**