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Examination: B.Tech. End Semester Examination, November-2022

Branch : Electrical Engineering Semester : III[rd]

Course : Electromagnetic Field Theory Code : EE-212

Time: 03:00 Hours **Maximum Marks: 50**

Instruction: Attempt all the questions.

Q. 1. What is the statement of the Divergence of a vector and explain it with suitable example. Also give the statement of the Divergence theorem and prove it. **[05]**

Q. 2. Point charges 2 mC and -4 mC are located at (3, 2, -1) and (-1, -1, 2), respectively. Calculate the electric force on a 20 nC charge located at (0, 2, 1) and the electric field intensity at that point. **[05]**

Q. 3. A circular loop located on $x^2 + y^2 = 9, z = 0$ carries a direct current of 10 A along a_ϕ. Determine H at (0, 0, 7) and (0, 0, -7). **[05]**

Q. 4. Two extensive homogeneous isotropic dielectrics meet on plane $z = 0$. For $z > 0$, $\varepsilon_{r_1} = 4$ and for $z < 0$, $\varepsilon_{r_2} = 3$. A uniform electric field $E_1 = 5a_x - 2a_y + 3a_z$ kV/m exists for $z \geq 0$. Find:

(i) E_2 *for* $z \leq 0$

(ii) The angles E_1 and E_2 make with the interface

(iii) The energy densities (in J/m^3) in both dielectrics

(iv) The energy within a cube of side 2 m centered at (3, 4, -5) **[05]**

Q. 5. Planes $z = 0$ and $z = 6$ carry current $K = -15a_x$ A/m and $K = 15a_x$ A/m respectively. Determine H at (a) (2, 2, 2) (b) (0, -4, 12) **[05]**

Q. 6. In a lossless dielectric for which $\eta = 60\pi$, $\mu_r = 1$, and $H = -0.1\cos(\omega t - z)a_x + 0.5\sin(\omega t - z)a_y$ A/m, calculate $\varepsilon_r, \omega, and\ E$. **[05]**

Q. 7. In a nonmagnetic medium $E = 4\sin(2\pi \times 10^7 t - 0.8x)a_z$ V/m

Find: (a) ε_r, η (b) The time-average power carried by the wave (c) The total power crossing 100 cm^2 of plane 2x + y = 5. **[05]**

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Q. 8. A certain transmission line 2 m long operating at $\omega = 10^6$ rad/s has $\alpha = 8\frac{\text{dB}}{\text{m}}, \beta = 1\frac{\text{rad}}{\text{m}}$, and $Z_0 = 60 + j40\ \Omega$. If the line is connected to a source of $10\angle 0^\circ$ V, $Z_g = 40\ \Omega$ and terminated by a load of $20 + j50\ \Omega$, determine (a) The input impedance (b) The sending-end current (c) The current at the middle of the line. **[05]**

Q. 9. What do you mean by Smith Chart and explain the following terms with example (i) r-circle, (ii) x-circle, and (iii) s-circle. Also, explain the procedure to draw the Smith Chart and application of the Smith Chart. **[05]**

Q. 10. In a rectangular waveguide for which $a = 1.5\ cm, b = 0.8\ cm, \sigma = 0,\ \mu = \mu_0, and\ \varepsilon = 4\varepsilon_0,$ $H_x = 2\sin\left(\frac{\pi x}{a}\right)\cos\left(\frac{3\pi y}{b}\right)\sin(\pi \times 10^{11}t - \beta z)$ A/m

Determine: (a) The mode of operation (b) The cutoff frequency (c) The phase constant β (d) The propagation constant γ (e) The intrinsic wave impedance η **[05]**

****** All the Best ******