Exam Date & Time: 28-Dec-2019 (09:30 AM - 12:30 PM)



MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES END SEMESTER THEORY EXAMINATIONS NOVEMBER2019 III SEMESTER B.sc. (Applied Sciences) in Engg. ELECTROMAGNETIC THEORY [IEC 233 - S2]

Marks: 100

Answer 5 out of 8 questions. Missing data, if any, may be suitably assumed. 1) (7) What is Polarization? Explain all types of Polarization. A) B) (7) if $\chi_m = 3.1$ for a material within which $\overline{B} = 0.4 y \overline{a_v}$ T find (i) \overline{H} (ii) μ (iii) μ_r (iv) \overline{M} (v) \overline{J} (vi) \overline{J}_{h} C) Consider two points A (-3, 2, 1) and B $(5,20^{\circ},-70^{\circ})$ find (i) the spherical coordinates of A (6) (ii) the rectangular coordinates of B(iii) the distance between A and B 2) (7) Derive an expression for inductance of a Solenoid. A) B) (7) An **H** field in free space is given as $\overline{H}(x,t) = 10\cos(10^8 t - \beta x)\overline{a}_y \text{V/m}$. Determine (i) β (b) $\lambda(ii) \overline{E}(x,t)$ at P (0.1,0.2,0.3) at t=1ns. C) Write short notes on (i) VSWR (ii) Critical angle (iii) Displacement Current (6) 3) (7) A charge QA =-10µC is located at A (-9,6,7) and a charge QB=50µC is at B (2,2,-2) in free space . If distance are given in meters, Determine A) $(i) \overline{R}_{AB}$ (ii) R_{AB} (iii) Determine the vector force exerted on Q_A by Q_B if $\varepsilon_0 = 8.854X10^{-12} F / m$ B) Explain (i) Phase Velocity (ii) Characteristic Impedance (iii) Reflection coefficient (7) C) Derive an expression for Electric Field for an infinite sheet charge placed in xy Plane by ⁽⁶⁾ using Gauss Law. (7) 4) Given the following values for P₁, P₂ and $I_1\Delta_1$ respectively, calculate ΔH_2 A) (i) $P_1(0,0,2)$, $P_2(4,2,0)$, $2\pi a_{\overline{a}} \mu Am$

(33) D₁ (0 2 0) D₂ (4 2 0) 2 $\pi \sigma$ $\mu \Lambda m$

Duration: 180 mins.

- ^{B)} Derive an expression for energy stored in an electrostatic. Write an expression for ⁽⁷⁾ stored Energy due to a uniform line charge distribution.
- ^{C)} Find the capacitance of two parallel plate capacitor using Laplace's Equation if both the ⁽⁶⁾ plates are separated at a distance of 'd' in a_x direction.
- Derive the boundary relations for Dielectric-Dielectric & Dielectric conductor interfaces ⁽⁷⁾ for static electric field.
 - A) B)

5)

6)

Find whether the following potentials satisfying Laplace's equation or not (i) $V = \frac{z \cos \phi}{\rho}$ (ii) $V = \frac{30 \cos \theta}{r^2}$

C) What is Brewster angle? Starting with plane wave incidence at dielectric interfaces. (6)
Derive an expression for the Brewster angle.

(7)

(7)

(7)

- A) Find the equation of streamline that passes through the point P(-2,7,10) in the field $\overline{E} = 2(y-1)\overline{a_x} + 2x\overline{a_y}$
- B) Derive an expression for the inductance per unit length of a coaxial cable. If a coaxial (7) cable has inner conductor of radius 2 mm and outer conductor of radius 9 mm, determine the inductance per unit length(let relative permeability=1).
- C) Derive an expression foe magnetic field intensity at any point in an solenoid having N (6) number of turns carrying current 'I' A. Hence obtain the same at the center and sides.
- 7)
- A) A 150 MHz uniform plane wave in free space is described by $\overline{H_z} = (4 + j10)(2\bar{a}_x + j\bar{a}_y)e^{-j\beta z}$ A/m. (a) Find Numerical values for $\omega, \lambda \& \beta$ (b) Find $\overline{H}(z,t)$ at t = 1.5 ns, z = 20cm (c) What is

B)

E ?

(7)	
(/)	

The boundary is separated by of two perfect dielectric materials ε_1 and ε_2 , D1 is incident at angle θ_1 with respect to normal at the boundary surface. Prove that

$$D2 = D1 \sqrt{\cos^2 \theta_1 + \left(\frac{\varepsilon_2}{\varepsilon_1}\right)^2 \sin^2 \theta_1}$$

and
$$E_2 = E_1 \sqrt{\sin^2 \theta_1 + \left(\frac{\varepsilon_1}{\varepsilon_2}\right)^2 \cos^2 \theta_1}$$

C)

If $\mu_r = 24$, $\varepsilon_r = 13.55$ and $\overline{H} = 2\cos(10^{10}t - \beta x)\overline{a_z}$ A/m, using Maxwell's equation, find \overline{B} , \overline{D} , \overline{E} and β .

(7)

(6)

(6)

8)

A)

A uniform plane wave propagating in perfect dielectric medium has $\overline{E} = 500 \cos(10^t - \beta z)a_x \text{ v/m} \text{ and } \overline{H} = 1.1 \cos(10^7 t - \beta z)a_y \text{ A/m if the wave is travelling with a}$ velocity $u = 1.5x10^8 m/s$, Find ε_r , $\mu_r \beta$, λ and η

B)

Let $V = 2xy^2z^3 + 3\ln(x^2 + y^2 + 3z^2)$ V in free space. Evaluate each of the following quantities at P (3, 2,-1). (i). V (ii). |V|(iii). \overline{E} (iv). $|\overline{E}|$ (v). $\overline{a_N}$ (vi). \overline{D}

C)

The point charge Q = 18nC has a velocity of $5x10^6$ m/s in the direction $\overline{a_v} = 0.60\overline{a_x} + 0.75\overline{a_y} + 0.30\overline{a_z}$. Calculate the magnitude of the force exerted on the charge by the field.

(i).
$$\overline{B} = -3\overline{a_x} + 4\overline{a_y} + 6\overline{a_z}mT$$
.
(ii). $\overline{E} = -3\overline{a_x} + 4\overline{a_y} + 6\overline{a_z}KV/m$.

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