Question Paper

MANIPAL ACADEMY OF HIGHER EDUCATION

INTERNATIONAL CENTRE FOR APPLIED SCIENCES
THIRD SEMISTER B Sc.EXAMINATION NOV 2018
ELECTROMAGNETIC THEORY [IEC 233 - S2]

Marks: 100   **Duration: 180 mins.**

Answer 5 out of 8 questions.

1)   (7)

A) Find whether the following potentials satisfying Laplace's equation or not

(i) $V = \dfrac{z\cos\phi}{\rho}$ (ii) $V = \dfrac{30\cos\theta}{r^2}$

B) if $\chi_m = 3.1$ for a material within which $\overline{B} = 0.4y\overline{a}_y$ T find (i) $\overline{H}$ (ii) μ (iii) μ_r (iv) $\overline{M}$ (v) $\overline{J}$ (vi) $\overline{J}_b$ (7)

C) Consider two points A (-3, 2, 1) and B $(5,20^0,-70^0)$ find (i) the spherical coordinates of A (ii) the rectangular coordinates of B(iii) the distance between A and B   (6)

2) Derive an expression for   inductance of a Solenoid.   (7)

A)

B) An **H** field in free space is given as $\overline{H}(x,t) = 10\cos(10^8 t - \beta x)\overline{a}_y$ V/m. Find (a) β (b) λ(c) $\overline{E}(x,t)$ at P (0.1,0.2,0.3) at t=1ns.   (7)

C) Write short notes on (i) VSWR (ii) Critical angle (iii) Displacement Current   (6)

3)   (7)

A) A charge Q_A =-10μC is located at A (-9,6,7) and a charge Q_B=50μC is at B(2,2,-2) in free space .If distance are given meters , Find;

(i) $\overline{R}_{AB}$

(ii) $|R_{AB}|$

Determine the vector exerted on Q_A by Q_B if $\varepsilon_0 = 8.854 X10^{-12} F/m$

B) Write notes on (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 using Gauss Law.   (6)

4)   (7)

A)

Given the following values for P_1, P_2 and $I_1\Delta_1$ respectively, calculate ΔH_2

(i) $P_1\,(0,0,2)$, $P_2\,(4,2,0)$, $2\pi\overline{a_z}$ μAm

(ii) $P_1\,(0,2,0)$, $P_2\,(4,2,0)$, $2\pi\overline{a_z}$ μAm

B)   (7)

A steel pipe is constructed of a material for which $\mu_r = 180$ and $\sigma = 4 X 10^6 S/m$. The two radius are 6 & 8 m and the length is 80 m . if total current carried by the pipe is $2\cos 10^4 \pi t$ A. Find (i) skin depth (ii) the effective resistance (iii) the dc resistance

C)   (6)

Find the capacitance of two parallel plate capacitor using Laplace's Equation if both the plates are separated at a distance of 'd' in $\overline{a_x}$ direction.

5)

A) Derive the boundary relations for Dielectric-Dielectric &Dielectric - conductor interfaces for static electric field.   (7)

B) What is Polarization? Explain all types of Polarization.   (7)

C)   (6)

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.

6)

A) Find the equation of streamline that passes through the point P(-2,7,10) in the field   (7)
$\overline{E} = 2(y-1)\overline{a_x} + 2x\overline{a_y}$

B) A 150 MHz uniform plane wave in free space is described by   (7)
$\overline{H_z} = (4+j10)(2\overline{a_x} + j\overline{a_y})e^{-j\beta z}$ A/m. (a) Find Numerical values for ω, λ & β (b) Find $\overline{H}(z,t)$ at t $= 1.5$ ns, z $= 20$cm (c) What is $|E|_{max}$?

C) Derive an expression foe magnetic field intensity at any point in an solenoid having N number of turns carrying current 'I' A. Hence obtain the same at the center and sides.   (6)

7)

A) Derive an expression for the inductance per unit length of a coaxial cable. If a coaxial 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).   (7)

B) Derive the Poission's and Laplace's equations for the electric potential. Discuss the solution of Laplace's equation in spherical coordinates for a case where the potential varies only with respect to θ.   (7)

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

8)

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

B) Derive an expression for energy stored in an electrostatic. Write an expression for stored energy due to a uniform line charge distribution. (7)

C) Explain the Biot-Savart law and the Ampere's law. With the help of these, derive an expression for the magnetic field due to an infinite sheet of uniform current density. (6)

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