

Time : Three Hours

Max Marks 90

Note :

- Read the instructions carefully and strictly follow them.
- *The paper is in two Sections. Attempt all questions of a Section at one place. Otherwise the question will not be evaluated.*
- *Each question carry equal 15 marks.*
- *Make a distinction between Scalar, vector and phasor representation.*
- *Explanation must be given as and when needed.*
- *Write Roll No. and Name on Smith Chart (if used) and tag it with answer book.*
- *Notations have their usual meanings.*

Section-A

- (a) A transmission line of characteristic impedance 100Ω (approximately real) is terminated with impedance $80+j140 \Omega$. Obtain voltage reflection coefficient, standing wave ratio, the location of V_{min} on line. If the distance between successive voltage maxima is 20 m and the input impedance is $50+j50 \Omega$, calculate α and β . Use Smith Chart and explain the procedure clearly. (9)
 - (b) The measurement on 0.6 m long, lossless coaxial cable at 100 kHz shows a capacitance of 54 pF when the cable is open circuited and an inductance of $0.3 \mu\text{H}$ when it is short circuited. Determine the propagation constant γ and cable parameters. (6)
- (a) Explain parallel polarization when a plane wave is incident obliquely at the interface of perfect dielectric by defining each term through neatly drawn sketch and obtain the expression of reflection coefficient. Also obtain Brewster Angle in terms of media parameters. (9)
 - (b) Let the electric and magnetic fields in free space are specified as -

$$\vec{E} = \frac{500}{\rho} \cos(10^6 t + \beta z) \hat{a}_\phi \text{ V/m}$$

$$\vec{H} = \frac{H_0}{\rho} \cos(10^6 t + \beta z) \hat{a}_\rho \text{ A/m}$$

Determine H_0 and β such that these fields satisfy the Maxwell's equations. (6)

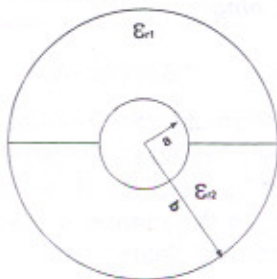
OR

- (a) A uniform sinusoidal plane wave with phasor $\vec{E}_i(x, z) = 10e^{-j(6x+8z)} \hat{a}_y$, from air is incident on a dielectric slab ($z \geq 0$) with $\mu_r = 1.5$, $\epsilon_r = 2.5$, $\sigma = 0$ at $z=0$. Find angles of incidence and transmission, reflected \vec{E}_r and transmitted \vec{H}_t . Take cosine as the reference for relating phasor and time varying fields. (9)
- (b) Determine the value of k and \vec{H} for the field $\vec{E} = \frac{E_0}{r} \sin \theta \cos(\omega t - kr) \hat{a}_\theta$ in free space while satisfying Maxwell's Equations. (6)

3. (a) A plane wave propagating through dielectric having an intrinsic impedance of $100\angle 30^\circ$ ohm at a given frequency, has magnetic field intensity as $\vec{H} = 10e^{-\alpha x} \cos(\omega t - x/2)\hat{a}_y$ A/m. Find α , β , \vec{E} , average power density carried by wave and power crossing through an area of 100 cm^2 of $x=0$ plane. (9)
- (b) Obtain the identity for the tangential components of magnetic field at the boundary interface as $\vec{H}_{t1} - \vec{H}_{t2} = \vec{K} \times \hat{a}_{n2}$. (6)

Section-B

4. (a) Deduce the capacitance for the spherical capacitors shown below and calculate it for $a=1.5 \text{ mm}$, $b=4 \text{ mm}$ $\epsilon_{r1}=2.5$ and $\epsilon_{r2}=3.5$. (9)



- (b) Obtain the expression of electrostatic potential at a point inside and outside a uniformly charged sphere of radius 'a'. (6)
5. (a) Show that the electrostatic energy in terms of field quantities can be expressed as
$$W_E = \frac{1}{2} \int_{\text{volume}} \vec{D} \cdot \vec{E} \, dv$$
 (9)
- (b) Let the region $0 \leq z \leq 2 \text{ m}$ is occupied by the magnetic material $\mu_r = 6.5$. If $\vec{H} = 10\hat{a}_x + 25\hat{a}_y - 40\hat{a}_z$ A/m. Find \vec{M} , \vec{J} , \vec{J}_b and \vec{K}_b on $z = 0$. (6)

OR

- (a) Discuss the magnetization in magnetic materials and obtain the expression of bound surface and volume current densities. Also show that $\vec{B} = \mu_0 \vec{H} + \vec{M}$ (9)
- (b) A circular ring, $\rho = 2 \text{ m}$, $z = 1 \text{ m}$, carries a uniform charge density of 8 nC/m , and the plane $z = 0$ is perfectly conducting. Assume the region $z > 0$ is free space. Find V at $P(0,0,z)$, $z > 0$. (6)
6. (a) Let the vector field $\vec{F} = (x + C_1z)\hat{a}_x + (C_2x - 3z)\hat{a}_y + (x + C_3y + C_4z)\hat{a}_z$. Determine (i) \vec{F} if it is irrotational and solenoidal (ii) the scalar potential function V whose negative gradient equals \vec{F} as computed in (i). (9)
- (b) Explain the inconsistency in the Ampere Circuital Law and the subsequent modification by Maxwell leading to the concept of displacement current. (6)

The evaluated answer sheets can be seen on 13th Dec 06 in C-104 as follows –

EE – 2.00-2.30, EIC-2.30-3.00, EC-3.00-4.00

The Complete Smith Chart

Black Magic Design

