5. Attempt any **two** parts of the following : **(10×2=20)**

(a) Discuss the structure of Smith Chart. How it is used for measurement of impedances and VSWR ?

(b) Relate short circuit, open circuit and characteristic impedance of Transmission line. The short circuit and open circuit impedance of 10 km long open wire transmission line are Z_{sc}=2930 $\angle 26^0$ and Z_{oc} = 260 $\angle -32^0$ at a frequency of 1 kHz. Calculate the characteristics impedance and phase velocity.

(c) Define reflection loss, transmission loss and return loss. The 600 Ω lossless transmission line is fed by 50 Ω generator. If the line is 200 meter long and terminated by load 500 Ω. Determine in db

(i) Reflection loss

(ii) Transmission loss

(iii) Return loss.

(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0324 Roll No.

B.Tech.

(SEM. III) THEORY EXAMINATION 2011-12

ELECTROMAGNETIC FIELD THEORY

Time : 3 Hours *Total Marks : 100*

Note :– (1) **All** questions carry equal marks.

(2) Attempt **all** questions.

1. Attempt any **four** parts of the following : **(5×4=20)**

(a) Given vector field G = 8 sin φ a_r in spherical coordinate Transform it into :

(i) Rectangular Coordinate

(ii) Cylindrical Coordinate

(b) Find the gradient of the following scalar field

(i) $V = e^{-Z} \sin 2x \cosh y$

(ii) $U = P^2 Z \cos 2\varphi$

(c) Derive expression for electric field due to infinitely long wire.

(d) Write down the expression/statement of the :

(i) Maxwell's curl equation for time varying field.

(ii) Differential form of Ampere's law.

(e) Given a vector function :

$\bar{A} = (3x+4z)\,\bar{a}_x + (c_2x-5z)\,\bar{a}_y + (4x-c_3y+c_4z)\,\bar{a}_z$

Calculate c_1, c_2, c_3, c_4 if $\bar{A}$ is irrotational and solenoidal.

(f) A charge distribution with spherical symmetry has density $\rho_v = \rho_0\, r/R$, $0 \leq r \leq R$ and 0 for $r > R$, Determine E everywhere.

2. Attempt any **two** parts of the following : **(10×2=20)**

(a) Derive Energy density in electrostatic field. A sphere of volume 0.1 m^3 has a charge density of 8.0pc /m^3. Find the electric field at a point (2,0,0) if the centre of the sphere is at (0,0,0).

(b) State and explain the Coulomb's law. If the current density $J=1/r^2\,(\cos\theta\, a_r + \sin\theta\, a_\theta)$. A/$m^2$, find the current passing through a sphere of radius 1.0 m.

(c) Discuss the relevance of uniqueness theorem. A spherical condenser has capacity of 54 pF. It consist of two concentric sphere differing in radius by 4 cm and having an air as dielectric. Find their radii.

3. Attempt any **four** parts of the following : **(5×4=20)**

(a) Write down the boundary condition for current density and postulates of Magnetostatics in free space.

(b) Prove that $B = (\mu_0\, I_b^2/4R^3)\,(a_R 2\cos\theta + a_\theta \sin\theta)$ for magnetic dipole.

(c) Given that $H_1 = -2a_x+6a_y+4a_z$ A/m in region $y-x-2\leq 0$ where $\mu_1=5\mu_0$ calculate M_1 and B_1.

(d) Find inductance of coaxial cable.

(e) Explain the relevance of Magnetic scalar and vector potential.

(f) In a material for which $\sigma=5$ S/m and $\varepsilon_r=1$, the electrical field intensity is $E=250\sin 10^{10}t$ V/m. Find conduction and displacement current densities and the frequency at which both have equal magnitude.

4. Attempt any **two** parts of the following : **(10×2=20)**

(a) Derive the expression for α and β in a conducting medium. Explain skin effect and depth of penetration.

(b) Derive the wave equation for conducting media. A uniform plane wave is propagating in the +z direction in a good conductor having conductivity σ S/m. The permittivity and permeability In the conductor are the same as in free space and the electric field is xE_0 at $z = 0$. What power (W/m^2) is dissipated in this medium foe $z > 0$? Assume $\sigma \gg \omega\varepsilon$.

(c) Derive Faraday law of induction. Explain the concept of Transformer and motional electromotive force. Discuss the relevance of Anisotropic media.