BTS – V – 11.14 – 0926 Reg. No. | | | | | | | | |

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B.Tech. Degree V Semester Examination November 2014

EE 1506 FIELD THEORY

(*2012 Scheme*)

Time: 3 Hours Maximum Marks: 100

PART A

(Answer *ALL* questions)

(8 × 5 = 40)

I. (a) State and prove divergence theorem.

(b) State and prove Stoke's theorem.

(c) State and explain Maxwell's equations in differential and integral forms.

(d) Explain magnetic scalar and vector potential.

(e) What is skin depth? Obtain an expression for skin depth.

(f) State and prove Poynting theorem.

(g) State and prove Snell's law of refraction.

(h) Derive the expression for input impedance of a transmission line terminated in its load impedance.

PART B

(4 × 15 = 60)

II. (a) Convert the following vector to Cartesian coordinates.
$A = \sin\theta\ ar / r^2 + \cos\theta\, a\theta / r^2$

(b) A cylindrical capacitor has radii $a = 1cm$ and $b = 2.5cm$. If the space between the plates is filled with an inhomogeneous dielectric with $\varepsilon_r = (10+\rho)/\rho$, where ρ is in cm, find the capacitance per meter of the capacitor.

OR

III. (a) Transform the vector $A = 2\ a_x + 5a_y$ at the point $P(x=2, y=1, z=3)$ into cylindrical coordinate system.

(b) To point charges $-4\ \mu C$ and $5\ \mu C$ are located at $(2m, -1m, 3m)$ and $(0, 4m, -2m)$ respectively. If the potential at $(0, 1m, 2m)$ is 5V, determine the potential at $(1m, 1m, 0)$.

IV. (a) State Ampere's law. Derive the expression for magnetic field intensity at any point around an infinite filamentary line current using Ampere's law.

(b) A wire carrying 100A current is bent into a square of side 10cm. Calculate the field at the centre of the coil.

OR

V. (a) Derive the boundary conditions for magnetic fields at the dielectric interface.

(b) A circular loop located on $x^2 + y^2 = 9$, $z = 0$ carries a direct current of 10A along a_ϕ. Determine H at $(0, 0, 4)$ and $(0, 0, -4)$.

(P.T.O.)

VI. (a) What are standing waves? Explain how they are formed along a transmission line.

(b) Derive the expressions for the electric and magnetic field components of a uniform plane wave propagating in a lossy dielectric.

OR

VII. (a) What is intrinsic impedance? Obtain the intrinsic impedance of free space.

(b) In free space $(z \leq 0)$, a plane wave with $H = 10\cos\left(10^8 t - \beta z\right) a_x mA/m$ is incident normally on a lossless medium with $\varepsilon = 2_{\varepsilon_0}$ and $\mu = 8\mu_0$. If the lossless medium lies in region $(z \geq 0)$, determine the reflected and transmitted components of electric and magnetic fields associated with the wave.

VIII. (a) Derive the expressions for reflection coefficient and transmission coefficient for a normally incident wave at a dielectric interface.

(b) A wave is incident at an angle of 30 degrees from air to teflon with $\varepsilon_r = 2.1$. Calculate the angle of transmission.

OR

IX. (a) Derive the wave equations for voltages and currents for a transmission line.

(b) A transmission line of $Zo = 50\Omega$ is terminated by $Z_L = R_L = 100\Omega$. Find VSWR, Zmin and Zmax.

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