Printed Pages : 4

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EEC-303

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

PAPER ID : 131306

Roll No.

# B. Tech.

## (SEM. III) (ODD SEM.) THEORY EXAMINATION, 2014-15

## ELECTRO MAGNETIC FIELD THEORY

Time : 3 Hours] [Total Marks 100

**Note :** Attempt all questions. All questions carry equal marks.

**1** Attempt any **four** parts : **5×4=20**

(a) A vector in cylindrical co-ordinates is given as $A = 2\cos\theta\, a_r + 3ra_\theta - 8a_z$. Transform this into spherical co-ordinates.

(b) Obtain the surface integral of $F = k_1 xa_x + k_2 ya_y + k_3 za_z$ over the surface of unit sphere where $k_1$ $k_2$ and $k_3$ are constants.

(c) Give the physical significance of gradient, divergence and curl.

(d) If $A = \alpha a_x + 2a_y + 10a_z$, and

$B = 4\alpha a_x + 8a_y - 2\alpha a_z$, find the values of $\alpha$ for which vectors become perpendicular to each other.

(e) Find curl of the vector field $A(r, \theta, z) = rz \sin\theta\, a_r + 3rz^2 \cos\theta\, a_\theta$ at $(5,\ 90°, 1)$.

(f) Determine the Laplacian of scalar field $V = 10\, r \sin^2\theta \cos\varphi$.

2 Attempt any **four** parts : **5×4=20**

(a) State and explain Gauss's law.

(b) A circular disc of radius a is uniformly charged with $Q_S$ coulomb/$m^2$ and the disc lies on $z = 0$ plane with its axis along $z$-axis. Show that the field $E$ at $(0,\ 0,\ h)$ is $E = \left(Q_s / 2\epsilon_0\right)\left\{1 - h/\left(h^2 + a^2\right)^{3/2}\right\}$.

(c) Give the complete solution of the Laplace equation in spherical coordinates.

(d) Determine the force on a point charge of $10nC$ situated at $(0,\ 0,\ 5m)$ due to an uniformly distributed charge of $5mC$ over a circular disc of radius $r \leq 1\ m$ in $z = 0$ plane.

(e) An electron and proton separated by a distance of $10^{-11}$ m are symmetrically situated along z-axis with $z = 0$ being its bisecting plane. Find $V$ and $E$ at a point $P(3, 4, 12)$.

(f) A potential difference of 10 V is maintained across the two ends of a two meter long Cu wire. If the meantime between the collisions is $2.7\times10^{-14}$ sec, determine the electron mobility and drift velocity.

**3** Attempt any **two** parts : **10×2=20**

(a) Write the set of Maxwell's equations in vector form and integral form for static fields in general case. Give their word statements and physical significance.

(b) (i) State and explain the boundary conditions for magnetic field.

(ii) Give the concept of scalar and vector magnetic potential.

(c) (i) Find the expression of B at a distance r from the axis of long cylindrical wire of radius a carrying current Io.

(ii) Calculate the self-inductance per unit length of an infinitely long solenoid.

**4** Attempt any **two** parts : **10×2=20**

(a) Derive the expressions of $\alpha, \beta, v_p$ and $\eta$ for good conducting medium.

(b) Explain Faraday's law of electromagnetic induction. Obtain the expression for transformer e.m.f. and motional e.m.f.

(c) An electromagnetic wave is propagating at a frequency of 180 MHz in a medium characterized by $\mu_r = 1,$, $\epsilon_r = 25$ and $\sigma = 25\ mS/m$. Determine $\alpha, \beta, v_p$, $\eta$ and $\delta$.

**5** Attempt any **two** parts : **10×2=20**

(a) Derive the transmission line equations in terms of distributed parameters and discuss their solutions. Also give the concept of infinite line

(b) An open-wire transmission line has following parameters :

R=5 Ω/m, L=$5.2\times10^{-8}$ H/m, G=$6.2\times10^{-3}$mho/m and C=$2.13\times10^{-13}$ F/m.

Find $\gamma, \alpha, \beta, v_p$ and $Z_0$ at 4 GHz frequency.

(c) Derive the expression for input impedance of a transmission line of length $L$ having characteristic impedance $Z_o$ and terminated wish load impedance $Z_L$. Also write the values of input impedance for (i) shorted line (ii) open-circuited line and (iii) line terminated with $Z_o$.