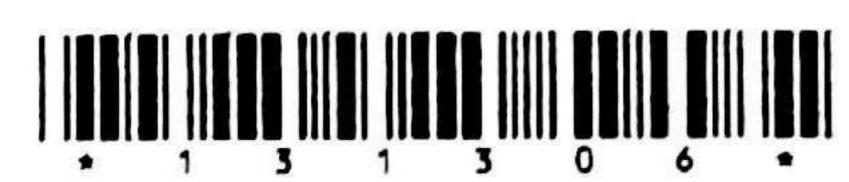
**EEC-303** 



(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.

Attempt any four parts:

 $5\times4=20$ 

- (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  $F = k_1 x a_x + k_2 y a_y + k_3 z a_z \text{ over the surface of unit sphere where } k_1 \ k_2 \text{ and } k_3 \text{ are constants.}$
- (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  $A(r, \theta, z) = rz \sin \theta \, a_r + 3rz^2 \cos \theta \, a_\theta \quad \text{at}$ (5, 90°,1).
- (f) Determine the Laplacian of scalar field V=10 r  $\sin^2 \theta \cos \phi$ .
- 2 Attempt any four parts:

 $5\times4=20$ 

- (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  $E = (Q_s/2 \in_0)$   $\left\{1-h/(h^2+a^2)^{3/2}\right\}$ .
- (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  $r \le 1$  m in z = 0 plane.

- (e) An electron and proton separated by a distance of 10<sup>-11</sup> 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 2.7×10<sup>-14</sup> sec, determine the electron mobility and drift velocity.

#### 3 Attempt any two parts:

 $10 \times 2 = 20$ 

- (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  $\alpha$ ,  $\beta$ ,  $\nu_p$  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  $\alpha$ ,  $\beta$ ,  $\nu_p$ ,  $\eta$  and  $\delta$ .

## 5 Attempt any two parts:

 $10 \times 2 = 20$ 

- (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  $\Omega/m$ , L=5.2×10<sup>-8</sup> H/m, G=6.2×10<sup>-3</sup>mho/m and C=2.13×10<sup>-13</sup> F/m.

Find  $\gamma$ ,  $\alpha$ ,  $\beta$ ,  $\nu_p$  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  $Z_o$ .

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