Printed Pages : 4

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 $F = k_1 x a_x + k_2 y a_y + k_3 z a_z$ 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 α 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 $E = (Q_s/2\epsilon_0)\left\{1 - h/\left(h^2 + a^2\right)^{3/2}\right\}$.

(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 2.7×10^{-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 α, β, v_p and η 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 α, β, v_p, η and δ.

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=5.2×10^{-8} H/m, G=6.2×10^{-3}mho/m and C=2.13×10^{-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.