(Pages : 3) **A – 4187**

Reg. No. : .....

Name : .....

Fourth Semester B.Tech. Degree Examination, June 2016
(2013 Scheme)
13.403 : ENGINEERING ELECTROMAGNETICS (E)

Time : 3 Hours Max. Marks : 100

PART – A

Answer **all** questions, **each** carries **2** marks.

1. If $D = 5\,ra_r + 4\,r\cos\theta a_\theta\ c/m^2$, calculate the flux density by the region given by $r = 6$ cm, $\theta = 30°$ to $45°$ and $\phi = 60°$ to $105°$.

2. Determine the force on – 2 nC point charge located at (2, – 5, 3) due to a point charge 3 nC at (3, – 2, – 1) in an air medium.

3. What is a dipole and dipole moment ?

4. Calculate the relaxation time for the medium with $\varepsilon = \varepsilon_0$ and $\sigma = 5.2 \times 10^7$ S/m at f = 1 MHz.

5. Find the capacitance of the earth if the radius is 6257 km.

6. If $H = 5\rho\cos\phi\ a_\rho\ A/m$, find the current density J.

7. Find the relation between group velocity and phase velocity.

8. If E = 100 v/m in air medium, find the Poynting vector.

9. Write the expressions for α and β transmission parameters.

10. What is skin depth and what are the factors affecting it ?

P.T.O.

PART – B

Answer **any one** question from **each** Module, **each** carries **20** marks.

Module – 1

11. a) Calculate the circulation of $A = \rho\cos\phi\, a_\rho + z\sin\phi\, a_z$ around the edge L of the wedge defined by $0 \le \rho \le 2$, $0 \le \phi \le 60°$, $z = 0$ and as shown in Figure 11.a

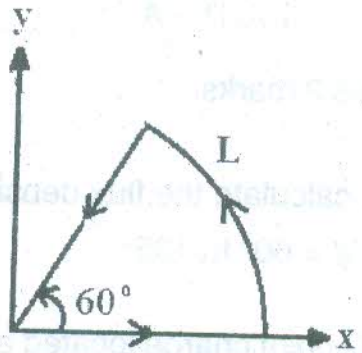

Fig. 11. a

b) Charges + Q and + 3Q are separated by a distance 2 m. A third charge is located such that the electrostatic system is in equilibrium. Find the location and the value of the third charge in terms of Q.

12. a) Let $\rho_v = \rho_0 / r\ nC/m^3$, $0 < r < a$, where ρ_0 is constant. Find E inside and outside of the sphere.

b) A uniform line charge density of 10 nC/m is positioned at x = 0, y = 2, while another uniform line charge density of – 10 nC/m is positioned at x = 0, y = – 2. Find the E at (1, 0, 0).

Module – 2

13. a) Derive an expression for potential and electric field intensity due to an electric dipole.

b) Find the energy stored in the hemispherical region $r \le 2m$, $0 < \theta < \pi$, $0 < \phi < \pi$, where $E = 2r\sin\theta\cos\phi\, a_r + r\cos\theta\cos\phi\, a_\theta - r\sin\phi\, a_\theta V/m$ exist.

14. a) Derive an expression for capacitance per unit length of a coaxial cable.

    b) Two homogeneous dielectric regions 1($\rho \leq 4$cm) and 2($\rho \geq 4$cm) have dielectric constants 3.5 and 1.5 respectively. If $D_2 = 12a_\rho - 6a_\phi + 9a_z nC/m^2$, calculate E_1 and D_1.

Module – 3

15. a) A cylindrical capacitor with inner radius a and outer radius b is filled with an inhomogeneous dielectric having $\varepsilon = \varepsilon_0 k/\rho$, where k is a constant. Calculate the capacitance per unit length of the capacitor. Use Laplace equation.

    b) Calculate the magnetic field intensity at the center of a square loop of side a cm carrying a current of I ampere in clockwise direction. The loop is at z = 0 plane.

16. a) The magnetic field intensity is given in a certain region of space as $H = [(x + 2y)/z^2]\, a_y + (2/z)a_z$ A/m. Verify the Stoke's theorem.

    b) Calculate the inductance per unit length of a two wire transmission line.

Module – 4

17. a) Derive the Maxwell's curl equations form the fundamental laws.

    b) A certain lossless material has $\mu_r = 4$ and $\varepsilon_r = 9$. A 10 MHz uniform plane wave is propagating in the a_y direction with $E_{x0} = 400$ V/m and $E_{yo} = E_{zo} = 0$ at P(0.6, 0.6, 0.6) at t = 60 ns. Find β, λ, v_p, η, E(t) and H(t).

18. a) Derive the wave equation and its solutions for a plane wave travelling in a conducting media.

    b) The fields of a 500 KHz uniform plane wave is a lossless dielectric are given by

    $E_s = (4\ 1x - 1y + 2\ 1z)\ 4$ KV/m

    $H_s = (6\ 1x + 18\ 1y - 3\ 1z)$ A/m.

    Find the unit vector in the direction in which the wave is travelling and also find Er if $\mu_r = 1$.