

Total No. of Questions : 8]

SEAT No. :

P2954

[Total No. of Pages : 3

[5669]-543

T.E. (E & TC)

ELECTROMAGNETICS

(2015 Pattern) (Semester - I)

Time : 2½ Hours]

[Max. Marks : 70

Instructions to the candidates:

- 1) Neat diagrams must be drawn wherever necessary.
- 2) Figures to the right side indicate full marks.
- 3) Use of Calculator is allowed.
- 4) Assume Suitable data If necessary.
- 5) Solve Q1 or Q2, Q3 or Q4. Q5 or Q6, Q7 or Q8.

**Q1)** a) Derive the expression for electric field intensity  $\vec{E}$  at a point P due to uniform charge distribution along an infinite straight line with uniform line charge density  $\rho_L$ . [8]

b) Derive the expression for capacitance of a parallel plate capacitor. [6]

c) Evaluate both sides of Stoke's theorem, for the field at  $\vec{H} = 6xy \hat{a}_x - 3y^2 \hat{a}_y$  A/m and the rectangular path around the region [6]

$2 \leq x \leq 5, -1 \leq y \leq 1, z = 0$ . Assume positive direction of  $\vec{ds}$  be  $\hat{a}_z$

OR

**Q2)** a) Derive the expression for the potential due to point charge. [6]

b) If  $\vec{J} = \frac{1}{r^3} (2 \cos \theta \hat{a}_r + \sin \theta \hat{a}_\theta)$  A/m<sup>2</sup>, find the current passing through [6]

i) A hemispherical shell of radius 20 cm,  $0 < \theta < \frac{\pi}{2}, 0 < \phi < 2\pi$  and

ii) A hemispherical shell of radius 10 cm.

c) Derive the boundary condition at an interface between two magnetic media. [8]

P.T.O.

**Q3) a)** State Maxwells equations for time varying electromagnetic fields in point form and integral form. Explain how these equations can be modified for harmonically varying EM fields in point form and integral form. [8]

b) Show that  $\bar{J}_D = \frac{\partial \bar{D}}{\partial t}$ . A parallel plate capacitor with plate area of 5 cm<sup>2</sup> and plate separation of 3 mm has a voltage  $50 \sin(10^3 t)$  V applied to its plates. Find displacement current assuming  $\epsilon = 2\epsilon_0$ . [8]

OR

**Q4) a)** Find value of k so that each of the following pair of fields  $\bar{E}$  and  $\bar{H}$  satisfies Maxwell's equation in the region where,  $\sigma = 0$ ,  $\rho_v = 0$ : [8]

i)  $\bar{E} = (kx - 100t)\hat{a}_y$  V/m

$\bar{H} = (x + 20t)\hat{a}_z$  A/m,  $\mu = 0.25$ ,  $\epsilon = 0.01$  F/m

ii)  $\bar{D} = 5x\hat{a}_x - 2y\hat{a}_y + kz\hat{a}_z \frac{\mu c}{m^2}$

$\bar{B} = 2\hat{a}_y$  mT,  $\mu = \mu_0$ ,  $\epsilon = \epsilon_0$

b) State and prove Poynting theorem. Interpret the significance of each term. [8]

**Q5) a)** Derive the expression for characteristic impedance and propagation constant in terms of primary constants of transmission line. [8]

b) Find primary constants R, L, G, C of a transmission line, if characteristic impedance is  $692 \angle -12^\circ$  ohm and propagation constant is  $0.0363 \angle 78^\circ$  at the frequency of 1 KHz. [8]

OR

**Q6) a)** What is distortion less line? Derive the condition for distortion less line. What are types of distortion in a transmission line. [8]

b) A Lossless transmission line with characteristic impedance 50 ohm is 30m long and operates at 2 MHz. Transmission line is terminated with a load impedance of  $60 + j40$  ohm. If velocity is  $0.6C$  (C is speed of EM wave in free space) on the line, using Smith Chart determine: [8]

i) Reflection coefficient

ii) SWR

iii) Input Impedance

iv) Load admittance

- Q7)** a) Define skin depth (or depth of penetration) for a good conductor. Obtain the expression for the same. Find the depth of penetration for Cu at 1 MHz,  $\sigma = 6 \times 10^6$  s/m  $\mu_r = 1$ . [10]
- b) Explain Snell's Law using reflection of a plane wave at oblique incidence [8]

OR

- Q8)** a) Define polarization of uniform plane waves? Explain the types of same. [8]
- b) What are the different types of media? Obtain Helmholtz's equation for a lossy dielectric. Also obtain the solution of Helmholtz's equation for a wave travelling in lossy dielectric along positive Z direction. [10]

