S.E-Sem IV - Choicebase - Electrical Engg. 29/05/18 May 18

Electromagnetic field & Wave Theory 01/01.

Q.P.Code: 38368

Duration: 3Hrs **Marks: 80**

N.B. 1. **Q.No.1 is compulsory**
2. Solve **any three** out of remaining questions.
3. Assume suitable data wherever necessary and justify the same.

Q.1 Solve **any four**:- **20**

a) An electric field at a point P ,expressed in cylindrical coordinate system is given by $\overline{E} = 6r^2 \sin\phi \overline{a_r} + 2r^2 \cos\phi \overline{a_\phi}$
Find the value of divergence of field if the location of point P is given by (5, 5, 5) in cartesian coordinate system.

b) State Gauss' law in point and integral form and give two examples.

c) Explain magnetic forces acting on conductor carrying current I and electric charge Q moving with fixed velocity $\overline{U}$.

d) Derive the expression for conduction and displacement current density.

e) What are the parameters of electromagnetic waves and give their role?

Q.2 a) Derive an electric field intensity due to a finite volume, having density $\rho_v(C/m^3)$. **10**

b) The electric flux density is given as $\overline{D} = \frac{r}{4}\overline{a_r}$ nC/m^2 in free space. Calculate (a) the electric field intensity at r=0.25m,(b)the total charge within a sphere of r=0.25m,and(c)the total flux leaving the sphere r=0.35m. **10**

Q.3 a) Obtain $\overline{H}$ due to finite circular closed current carrying conductor and an infinitely long straight filament of current I. **10**

b) Potential is given by $V = 2(x+1)^2(y+2)^2(z+3)^2$ V in free space. At a point P(2,-1,4)calculate (i)the potential at point P,(ii)electric field intensity $\overline{E}$ at point P (iii)flux density $\overline{D}$ at point P,(iv)volume charge distribution ρ_v at point P, and (v)unit vector in the potential gradient direction at P. **10**

Q.4 a) A boundary exists at z=0 between two dielectrics $\varepsilon_{r1} = 2.5$ region z<0,and $\varepsilon_{r2} = 4$ region z>0.The field in the region 1 is $\overline{E_1} = -30\overline{a_x} + 50\overline{a_y} + 70\overline{a_z}$ V/m. Find (a)normal component of $\overline{D_2}$ (b)tangential component of $\overline{D_2}$ (c)polarization in the second medium,(d)angle between $\overline{E_2}$ and normal to the surface. **10**

b) A straight conductor of 0.2m lies on the x axis with one end at origin. The conductor is subjected to a magnetic flux density $\overline{B} = 0.04\overline{a_y}$ T and velocity $v=2.5\sin 10^3 t\,\overline{a_z}$ m/s. Calculate the motional electric field intensity and emf induced in the conductor. **10**

Q.5 a) Derive Maxwell- Faraday's electromagnetic induction equation in the time domain and explain them in frequency domain. **10**

b) An a. c. voltage source $v = V_o \sin\omega t$ is connected across a parallel plate capacitor C. Find the relation between displacement and conduction current of the wires. **10**

Q.6 a) Derive wave equation and its simplest form for partial conducting medium. **10**

b) Given $\overline{E}(x,t) = 10^3 \sin(6X10^8 t - \beta x)\overline{a_y}$ V/m in free space, sketch the wave at t=0 and at time t_1, when it has travelled $\lambda/4$ along the x-axis. Find t_1, β and λ. **10**