EE - old - sem - V - EFW 18/11/2015

QP Code : 1607

Duration: 3 hrs Total Marks: 100

NOTE:

1. Question No 1 is compulsory
2. Solve any four out of remaining six questions
3. Figures on right hand indicate full marks
4. Assume suitable data if necessary

Q1) Solve any Four [20]

a. Prove that the line integral of H around a single closed path is equal to the current enclosed by that path.
b. A charge of Q coulombs is placed at (0,0,0) and same amount of charge is also place at (10,0,0).find out E as a function of x along x-axis for $0 \le x \le 10$.
c. The circular loop conductor having a radius of 0.15 m is placed in the X-Y plane. This loop consists of a resistance of 20Ω, if the magnetic flux density is $\bar{B} = 0.5\sin(10^3 t)\,\bar{a}_z$ tesla, find the current flowing through this loop.
d. Prove that curl of gradient of a scalar function is zero i.e. $\nabla \times (\nabla \Phi) = 0$.
e. Prove the differential relation $\bar{E} = -\nabla V$.
f. Define Gauss's law for electric and magnetic field in static field.

Q2) [20]

a. Charge lies in the z = -3m plane in the form of a square sheet defined by $-2 \le x \le 2m, -2 \le y \le 2m$ with charge $\rho_s = 2(x^2+y^2+9)^{3/2}$ ηc/m^2.
b. Given that $\bar{D} = (5r^2/4)\,\bar{a}_r$ in spherical coordinates, evaluate both sides of the divergence theorem for the volume enclosed between r = 1 and r = 2.

Q3) [20]

a. If $V = 20\sin\theta/r^3$ (volts) in free space, find
   1. Pv at P(r=2,θ=30°,Φ = 0),
   2. The total charge within the spherical shell $1<r<2m$.
b. An E-field is given by $\bar{E} = 4x\bar{a}_x + 2\bar{a}_y$ V/m. Determine by direct integration the work required to move a unit positive charge along the curve xy=4 from (2, 2) to (4, 1).

Q4) [20]

a. The region x<0 contains dielectric medium for which $\varepsilon_{r1}=4$, while the region x>0 is characterized by $\varepsilon_{r2}=2$, if $\bar{E}_1 = 50\,\bar{a}_x - 30\bar{a}_y + 60\bar{a}_z$ Kv/m. find 1. $\bar{E}_{n_1}$, 2. θ_1 3. $\bar{E}_{t_1}$, 4. $\bar{E}_2$, 5. θ_2.
b. Derive the expression for magnetic field intensity on the axis of a circular loop.

[TURN OVER]

Q5) [20]

a. A radial field $\bar{H} = 2.39 \times 10^6/r \cos\Phi \, \bar{a_r}$ (A/m) exits in free space. Find the magnetic flux Φ crossing the surface defined by $-\pi/4 \leq \Phi \leq \pi/4$, $0 \leq z \leq 1$m.

b. Let the current density in cylindrical system be
$\bar{J} = 2r\cos^2\Phi \, \bar{a_r} - r\sin 2\Phi \, \bar{a_\Phi}$ (A/m^2)
Within the region $2.1 < r < 2.5$, $0 < \Phi < 0.1$rad, $6 < z < 6.1$. Find the total current I crossing the surface r= 2.2, $0 < \Phi < 0.1$rad, $6 < z < 6.1$ in the ar direction also evaluate V J at P(r=2.5,Φ=0.08 and z=6.05).

Q6) [20]

a. Derive the Maxwell equation for static field.

b. A lossy dielectric has $\mu r = 1$ and $\varepsilon r = 1, \sigma = 2 \times 10^{-8}$ (s/m). An electric field $\bar{E} = 2000 \sin\omega t \, \bar{a_z}$ V/m at a certain point in the dielectric.
   1. At what frequency the conduction and displacement current densities be equal?
   2. At this frequency calculate the instantaneous displacement current density.

Q7) [20]

a. Derive the expression for pointing theorem and state significance of each term.

b. Starting from Maxwell equation obtain wave equation for the field E and H for free space.
