Total No. of Questions : 6]

SEAT No. :

P5075

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T.E./Insem.-623

T.E. (E & TC) (Semester - I)

ELECTROMAGNETICS

(2015 Pattern)

Time : 1 Hour] *[Max. Marks : 30*

Instructions to the candidates:

1) ***Answer Q.1 or Q.2, Q.3 or Q.4, Q.5 or Q.6.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right side indicate full marks.***
4) ***Use of calculator is allowed.***
5) ***Assume suitable data if necessary.***

Q1) a) A uniform line charge of $4\mu C/m$ is located on the y axis. Find $\bar{E}$ in Cartesian coordinates at P(3, 1, 2) if the charge extends from: **[6]**

i) $-\infty < y < \infty$,

ii) $-5 < y < 10$.

b) Derive an expression for the potential difference V_{AB} between point A and B, in presence of an uniform line charge with charge density ρ_L lying on entire Z-axis $(-\infty \text{ to } \infty)$. **[4]**

OR

Q2) a) Using Gauss's Law, derive an expression for electric field intensity ($\bar{E}$) at point P in free space, due to infinite surface charge with charge density ρ_s, placed on entire Z = 0 plane. Consider point P towards positive side of Z = 0 plane. **[6]**

b) Four infinite uniform sheets of charge are located as follows $20\,pC/m^2$ at $y = 7, -8\,pC/m^2$ at $y = 3, 6\,pC/m^2$ at $y = -1$ and $-18\,pC/m^2$ at $y = -4$. Find $\bar{E}$ at the point : **[4]**

i) A (2, 6, –4),

ii) B (0, 0, 0),

iii) C (–1, –1.1, 5).

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Q3) a) Derive electrostatic boundary conditions for the boundary between two perfect dielectric materials. **[6]**

b) Let $\varepsilon_{r1} = 2.5$ for $0 < y < 1$ mm, $\varepsilon_{r2} = 4$ for $1 < y < 3$ mm, and ε_{r3} for $3 < y < 5$ mm. Conducting surfaces are present at $y = 0$ and $x = 5$mm. Calculate the capacitance per square meter of surface area if : **[4]**

i) ε_{r3} is that of air;

ii) $\varepsilon_{r3} = \varepsilon_{r1}$;

iii) $\varepsilon_{r3} = \varepsilon_{r2}$;

iv) region 3 is silver.

OR

Q4) a) Derive an expression for energy stored in an electrostatic field in terms of $\bar{D}$ & $\bar{E}$. **[6]**

b) Two extensive homogeneous isotropic dielectrics meet on plane $z = 0$. For $z > 0$, $\varepsilon_{r1} = 4$ and $z < 0$, $\varepsilon_{r2} = 3$. A uniform electric field $\bar{E}_1 = 5\hat{a}_x - 2\hat{a}_y + 3\hat{a}_z \, kV/m$ exists for $z \geq 0$. **[4]**

Find : i) $\bar{E}_2$ for $z \leq 0$;

ii) The angle which E_1 makes with the interface;

iii) The energy densitie (in J/m^3) for $z > 0$.

Q5) a) i) Find $\bar{H}$ in Cartesian components at P(2, 3, 4) if there is a current filament on the z axis carrying 8mA in the $\bar{a}_z$ direction.

ii) Repeat if the filament is located at $x = -1$, $y = 2$.

[6]

b) Write Maxwell's equation in point form and integral form for static electric and steady magnetic fields. **[4]**

OR

Q6) a) Let $\bar{H} = 15r\bar{a}_\phi \, mA/m$.

i) Determine current enclosed by the circular path $r = 5$, $\theta = 25°$, $0 \leq \phi \leq 2\pi$ by using line integral side of Stokes theorem.

ii) Determine current by surface integral side of Stokes theorem.

[6]

b) State and prove Ampere Circuital Law. **[4]**

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