Total No. of Questions : 10]

SEAT No. :

P1994

[Total No. of Pages : 3

[5059]-589
B.E. (Electrical) (Semester - I) (Elective - II)
ELECTROMAGNETIC FIELDS
(2012 Pattern)

Time : 2.30 Hours] *[Max. Marks : 70*

Instructions to the candidates:

1) ***Answer Q1 or Q2, Q3 or Q4, Q5 or Q6. Q7 or Q8, Q9 or Q10.***
2) ***Neat diagrams must be drawn wherever necessary.***
3) ***Figures to the right indicate full marks.***
4) ***Use of logarithmic tables, slide rule, Mollier Charts, electronic pocket calculator and steam tables is allowed.***
5) ***Assume Suitable data if necessary.***

Q1) a) Obtain the expression for E and D due to infinite line charge ρ_1 C/m using Gauss's law. **[6]**

b) A current distribution gives rise to vector magnetic potential **[4]**

$$\bar{A} = x^2 y\hat{a}_x + y^2\hat{a}y - 4xyz\hat{a}_z \; Wb/m.$$

Calculate B at (1,2-5).

OR

Q2) a) Find the energy stored in free space for the region $2 < r < 3$ mm, $0 < \theta < 90^o$, $0 < \varphi < 90^o$, given the potential field $V = \frac{200}{r}V$. **[6]**

b) Derive Poisson's equation $\nabla^2 V = -\frac{\rho_v}{\varepsilon}$ from Gauss's law. Explain its physical significance. **[4]**

Q3) a) Obtain the H (magnetic field intensity) due to a finite long straight conductor carrying current I at any point P using Biot Savart's law. **[6]**

b) Two point charges $Q_1 = 3$ nC and $Q_2 = -2$ nC are placed at (0,0,0) and (0,0,–1) respectively. Assuming zero potential at infinity, find the potential at (0,1,0). **[4]**

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OR

Q4) a) Derive an expression for the point form of Ampere's circuital law, **[6]**

$$\nabla \times \bar{H} = \bar{J}$$

b) If $\bar{J} = \frac{100}{\rho^2}\hat{a}_p$ A/m^2, find the total current I passing through surface defined by $\rho = 2, 0 < z < 1, 0 < \varphi < 2\pi$ **[4]**

Q5) a) Region 1 described by $3x + 4y \geq 10$, is free space, whereas region 2 described by $3x + 4y \leq 10$, is a magnetic material for which $\mu = \mu_0$. Assuming that the boundary between the material and free space is current free, find $\bar{B}_2 \; if \; \bar{B}_1 = 0.1\hat{a}_x + 0.4\hat{a}_y + 0.2\hat{a}_z Wb/m^2$ **[8]**

b) Explain the concept of magnetization and permeability. **[8]**

OR

Q6) a) Derive an expression for energy in magnetostatic field. **[8]**

b) The point charge Q = 18nC has velocity of 5×10^6 m/s in the direction $\hat{a}_v = 0.60\hat{a}_x + 0.75\hat{a}_y + 0.30\hat{a}_z$. Calculate the magnitude of force exerted on charge by the field. **[8]**

i) $\bar{B} = -3\hat{a}_x + 4\hat{a}_y + 6\hat{a}_z mT;$

ii) $\bar{E} = -3\hat{a}_x + 4\hat{a}_y + 6\hat{a}_z KV/m;$

iii) B and E acting together

Q7) a) State Lenz's law. Using Faraday's law, derive an expression for transformer emf. **[8]**

b) Find the amplitude of the displacement current density in a metallic conductor at 60Hz if $\varepsilon = \varepsilon_0$, $\mu = \mu_0$, $\sigma = 5.8 \times 10^{-7}$. S/m and

$$\bar{J} = \sin(377t - 117 \cdot 1z)\hat{a}_x MA/m^2$$ **[8]**

OR

Q8) a) Write Maxwell's equation in point form for static electromagnetic fields and time varying fields. **[8]**

b) Explain motional electromotive force. **[8]**

Q9) a) What is poynting vector? What is its significance? Derive the expression of Poynting vector? **[10]**

b) Define uniform plane wave. Explian the significance of propagation constant and attenuation constant with respect to uniform plane wave.**[8]**

OR

Q10)a) State and explain Maxwell's equation in phasor form for time harmonic electromagnetic fields in a linear, isotropic and homogenous medium.**[10]**

b) Write the wave equations in phasor form for conductor. Explain skin effect. **[8]**