(Following Paper ID and Roll No. to be filled in your Answer Book)

PAPER ID : 0324 Roll No.

# B.Tech

## (SEM III) ODD SEMESTER THEORY EXAMINATION 2009-10

## ELECTROMAGNETIC FIELD THEORY

*Time : 3 Hours]* *[Total Marks : 100*

**Note :** *(1) Attempt **all** questions.*

*(2) All questions carry **equal** marks.*

1 Attempt any **four** parts of the following :

(a) Express vector $\bar{B} = \frac{10}{r} a_r + r \cos\theta \, a_\theta + a_\phi$ in cartesian coordinates.

(b) Given point $P(-2, 6, 3)$ and vector $\bar{A} = y a_x + (x+z) a_y$. Express $P$ and $\bar{A}$ in spherical system.

(c) Explain the gradient of a scalar field.

(d) State and explain the divergence theorem.

(e) Given $\bar{A} = 5a_{\bar{x}} - 2\bar{a}_y + \bar{a}_z$, find the expression of a unit vector $\bar{B}$ such that $\bar{B} \parallel \bar{A}$.

(f) State and explain the Stokes theorem.

2 Attempt any **four** parts of the following :

(a) The cable shown in Fig. 1, is 10 km long. If $r_1 = 10$ mm, $r_2 = 15$ mm, $r_3 = 20$ mm, $\in r_1 = 2.0$, $\in r_2 = 4.0$. Find the capacitance of the cable.

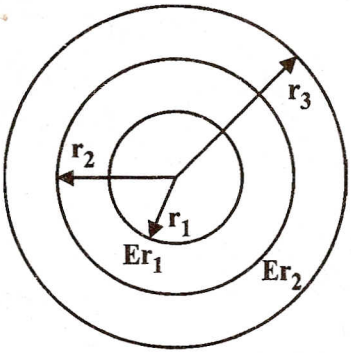


**Fig. 1**

(b) If the current density $J = \frac{1}{r^2}(\cos\theta a_r + \sin\theta a_\theta)$, A/m$^2$, find the current passing through a sphere radius of 1.0 m.

(c) If a potential $V = x^2yz + Ay^3z$, (i) find $A$ so that Lapace's equation is satisfied (ii) with the value of $A$, determine electric field at (2, 1, –1)

(d) State and explain the poisson's and Laplace's equation.

(e) State and explain the coulomb's law.

(f) A sphere of volume 0.1 m$^3$ has a charge density of 8.0 pc/m$^3$. Find the electric field at a point (2, 0, 0) if the centre of the sphere is at (0, 0, 0).

3 Attempt any **two** parts of the following :

(a) State and explain the Biot-Savrat law. What is the magnetic field, H in cartesian coordinates due to Z-directed current element ? Find J if I = 2 A.

(b) State and explain the Stokes theorem. When vector magnetic potential is given by

$A = \frac{1}{r^3}(2.0 \cos\theta\, a_r + \sin\theta\, a_\theta)$, find the magnetic flux density.

(c) An isotropic material has a magnetic susceptibility of 3 and the magnetic flux density, $B = 10y\, a_x$ mwb/m$^2$. Determine $\mu$, $\rho_n$, $J$, $M$ and $H$. Define inductance, mutual inductance and coefficient of coupling.

4 Attempt any **two** parts of the following :

(a) State and explain the Maxwell's equation in differential and integral form. Also define the displacement currrent and depth of penetration.

(b) Derive the relation between $\bar{E}$ and $\bar{H}$ in uniform plane wave.

(c) Derive the expression for $\alpha$ and $\beta$ in a conducting medium.

5 Attempt any **two** parts of the following :

(a) By using Smith chart, find the input impedance of 75 Ω lossless transmission line of length 0.1 λ. when the load is a short.

(b) The short circuit and open circuit impedance of 10 km long open wire transmission line are $Z_{sc} = 2930 \angle 26°$ and $Z_{oc} = 260 \angle -32°$ at frequency of 1 kHz. Calculate the characteristics impedance and phase velocity.

(c) Define reflection loss, transmission loss and return loss. The 600 Ω lossless transmission line is feeded by 50 Ω generator. If the line is 200 meter long and termintated by load 500 Ω. Determine in db (i) reflection loss (ii) Transmission loss (iii) return loss.

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