PAPER ID : 3081

TEC-401 Printed Pages : 4

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

Roll No. | | | | | | | | | | | |

B. Tech.

(SEM. IV) EXAMINATION, 2010

ELECTROMAGNETIC FIELD THEORY

Time : 3 Hours] [Total Marks : 100

Note : Attempt **all** questions.
All questions carry **equal** marks.

1 Attempt any **four** questions :

(a) Express the given vector

$\overline{A} = xy^2z\hat{a}_x + x^2yz\hat{a}_y + xyz^2\hat{a}_z$ in cylindrical and spherical coordinate system.

(b) State and prove the Gauss divergence theorem.

(c) Explain the physical interpretation of gradient, divergence and curl. Write down the expressions for divergence and curl in cylindrical and spherical polar coordinates.

(d) Evaluate divergence, curl and Laplacian of the following :

(i) $\overline{A} = x^2y\hat{i} + y^2z\hat{j} - 2xz\hat{k}$

(ii) $\overline{A} = \frac{\sin\phi}{r^2}\hat{a}_r - \frac{\cos\phi}{r^2}\hat{a}_\phi$

(e) Prove that

(i) $\nabla \bullet (\bar{A} \times \bar{B}) = \bar{B} \bullet (\nabla \times \bar{A}) - \bar{A} \bullet (\nabla \times \bar{B})$

(ii) $\nabla \times (\nabla \times \bar{A}) = \nabla (\nabla \bullet \bar{A}) - \nabla^2 \bar{A}$

(f) Computer the distance vector from $P(0,-2,1)$ to $Q(-2,0,3)$.

2 Attempt any **four** questions :

(a) Find the gradient of a scalar field $f(x,y,z) = 6x^2y^3 + e^z$ at the point P(2,1,0).

(b) Using cylindrical coordinate system, verify that $\nabla \cdot \hat{\rho} = 3$

(c) Show that divergence of a curl of a vector field is always zero, i.e., $\nabla \cdot \left(\nabla \times \vec{F} \right) = 0$.

(d) Give some physical examples of dot product and cross product.

(e) What is the significance of the curl of a vector.

(f) If $f = x^3y^2z$, determine ∇f at P(2,3,5).

3 (a) Derive electromagnetic plane wave equation in linear medium. On the basis of it deduce the plane wave equation

(i) Non-conducting medium

(ii) Conducting medium

(iii) Free space

(b) The electric field intensity of a uniform plane electromagnetic wave in air is 7.5 kV/m in y-direction. The wave is propagating in x-direction at a frequency of 2×10^9 *rad* / sec.

Determine :

(i) Wavelength of electromagnetic wave

(ii) Frequency

(iii) Time period

(iv) Magnitude of magnetic field intensity.

(c) What are the advantages of transmission lines ? Discuss various types of transmission lines.

4 (a) For a transmission line primary line constants are R=78N/km, G=62 μ mhos/km, L=1.75 mH/Km and C=.094 μ F/km. At a frequency of 1600 Hz, *Find*

(i) Characteristic impedance

(ii) Attenuation constant

(iii) Phase constant

(iv) Velocity

(v) Time taken by wave to travel 200 km along the line.

(b) Write down the Maxwell's equations and explain the physical interpretation of Maxwell's equations.

(c) Discuss the wave propagation in conducting media.

5 (a) State and prove Poynting theorem. State the physical interpretation of Poynting vector.

(b) Derive the field expressions for transverse electric waves.

(c) A travelling electric field in free space of amplitude 100 V/m strikes a sheet of thickness 5 mm as shown in **Fig. 1**. Given $\sigma = 61.7 \times 10^6\ S/m$, $f = 200\ MHz$. Find the amplitudes of $|\bar{E}_2|$, $|\bar{E}_3|$ and $|\bar{E}_4|$.

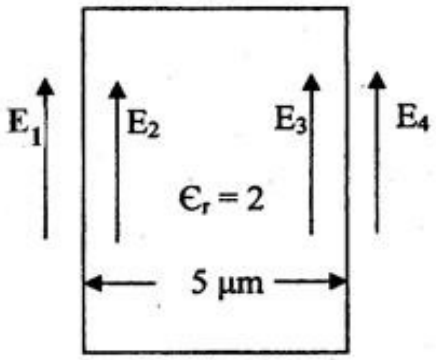

Fig. 1