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

Paper ID : 2012381 Roll No. | | | | | | | | | |

B.TECH

Regular Theory Examination (Odd Sem - V), 2016 - 17

FUNDAMENTALS OF E.M. THEORY

Time : 3 Hours *Max. Marks : 100*

Section - A

Attempt all parts. All parts carry equal marks. Write answer of each part in short. (10×2=20)

1. a) Given two vectors $\vec{A} = 4f_y + 10f_z$ and $\vec{B} = 2f_x + 3f_y$. Find the projection of $\vec{A}$ on $\vec{B}$.

   b) Given $\vec{A} = 5f_x - 2f_y + f_z$, find the expression of a unit vector f_B such that f_B is parallel to $\vec{A}$.

   c) Transform the vector $4f_x - 2f_y - 4f_z$ into spherical coordinates at a point P($x = -2, y = -3, z = 4$).

   d) A charge $Q_2 = 121 \times 10^{-9}$ c is located in vacuum at $P_2(-0.03, 0.01, -0.04)$. Find force on Q_2 due to $Q_1 = 100$ μc at $P_1(0.03, 0.08, 0.02)$. All distances in meters.

   e) Find the stored energy in a system of four identical charges Q = 2nc, at the corners 1m on a side.

f) What happens when a solid conductor is placed in an electric field?

g) Define - Polarization.

h) Explain - electric susceptibility.

i) Write and explain differential form of Faraday's law.

j) Explain the significance of displacement current.

Section - B

Attempt any five questions from this section

(5×10=50)

2. Write and explain integral and differential form of Maxwell's equations.

3. A lossless dielectric medium has $\sigma = 0$, $\mu_r = 1$ and $\varepsilon_r = 4$. An electromagnetic wave has magnetic filed components expressed as

$$\vec{H} = -0.1\cos(wt - z) f_x + 0.5\sin(wt - z) f_y \frac{A}{m}$$

Find

a) Phase constant β.

b) Angular velocity.

c) The wave impedance.

d) Electric field intensity.

4. What do you understand by skin effect? Define skin depth. Show that in case of a semi-infinite solid conductor, the skin depth S is given by $S = \sqrt{\frac{2}{w\mu\sigma}}$.

5. Show that for uniform plane wave in a perfect medium, $\vec{E}$ and $\vec{H}$ are normal to each other and the ratio of their magnitude is constant of the medium.

6. State and explain Biot-Savart's law for static magnetic fields as applied to different types of current distributions.

7. State and explain Ampere's law both in integral and differential form as used in magnetic field.

8. State and explain Gauss's law of electromagnetics in integral form.

9. Derive Poisson's and Laplace's equations from fundamentals.

Section - C

Attempt any two questions from this section

(2×15=30)

10. A total charge of 40 nc is uniformly distributed over a circular disc lying in xy plane with its centre at the origin (0, 0, 0). Find the potential at point (0, 0, 5)m.

11. Magnetic field intensity in free space is given by $\vec{H} = 20(xf_x + yf_y)/(x^2 + y^2)$ A/m

a) Show that $\vec{\nabla}.\vec{B} = 0$

b) Find the current density $\vec{J}$.

c) Find the scalar vector potential $V_m(x, y, z)$ if $V_m = 0$ at P(1, 1, 1).

12. Can a static magnetic field exist in the interior of a perfect conductor? Explain.

Can a time varying magnetic filed exists in the interior of a perfect conductor? Explain.