Registration No : | | | | | | | | | | |

Total Number of Pages : 02 **B.Tech**
PEE3I001

3rd Semester Back Examination 2019-20
ELECTROMAGNETIC THEORY
BRANCH : ELECTRICAL
Max Marks : 100
Time : 3 Hours
Q.CODE : HB821

Answer Question No.1 (Part-1) which is compulsory, any EIGHT from Part-II and any TWO from Part-III.
The figures in the right hand margin indicate marks.

Part-I

Q1 **Only Short Answer Type Questions (Answer All-10)** **(2 x 10)**

a) Prove that vectors obey the distributive law for the cross product.
b) How the maximum and minimum value of dot product and cross product are obtained from two vectors?
c) What is the significance of the curl of a vector?
d) Find the gradient of a scalar field defined by $f(x,y,z) = 6x^2y^3 + e^z$ at the point P(2,1,3).
e) Given $\vec{A} = 3\vec{a}_x + 2\vec{a}_y - \vec{a}_z$ and $\vec{B} = \vec{a}_x - 3\vec{a}_y + 2\vec{a}_z$. Find $\vec{C}$ such that $\vec{C} = 2\vec{A} - 3\vec{B}$. Find the unit vector $\vec{a}_c$ and the angle it makes with z-axis.
f) An electron is deflected upward when it passes through it passes through an electric field. What is the direction of electric field?
g) Why are the equipotential surfaces perpendicular to the electric flux lines?
h) Why is the induced electric field not a conservative field?
i) What do you mean by intrinsic impedance?
j) Why Pointing vector is required?

Part-II

Q2 **Only Focused-Short Answer Type Questions- (Answer Any Eight out of Twelve)** **(6 x 8)**

a) State electric dipole and dipole moment. An electron and a proton separated by a distance of 10^{-11} meter are symmetrically arranged along the z-axis with z=0 as its bisecting plane. Determine the potential and $\vec{E}$ field at P(3,4,12).
b) Two points $P(1,\pi,0)$ and $Q(0,\frac{-\pi}{2},2)$ are given in the cylindrical coordinate system. Find the distance vector from P to Q. What is the length? What the distance from Q to P? Express the distance vector from P to Q in terms of the distance vector from Q to P.
c) If $\vec{F} = r\vec{a}_r + r\tan\theta\vec{a}_\theta + r\sin\theta\cos\phi\vec{a}_\phi$. Transform $\vec{F}$ to the rectangular coordinate system.
d) Derive the expression of electric field due to a volume charge using both Coulomb's Law and Gauss's law.
e) State Poynting's theorem. What is Poynting vector?
f) If the electric field intensity in a source-free, dielectric medium is given by $\vec{E} = E_0[\sin(\alpha x - \omega t) + \sin(\alpha x + \omega t)]\vec{a}_y$ V/m, determine the magnetic field intensity using Maxwell's equation from Faraday's law. What is the displacement current density in the medium?
g) Write Maxwell's equations in (a) point form and (b) integral form. Explain the significance of each equation.

h) State electric dipole and dipole moment.

i) Evaluate $\oint \vec{\rho}.dl$ along the closed circular path of radius b in the xy plane.

j) Find the volume of a region bounded by the xy plane (z=0) and $z = 4 - x^2 - y^2$.

k) What is Stoke's theorem? What are its advantages and limitations? Can Stoke's theorem be applied to closed surfaces?

l) The electric field intensity of a wave in a region is given by $\vec{E} = 3\cos(\omega t - \beta x - 45^0)\vec{a}_y + 4\sin(\omega t - \beta x + 45^0)]\vec{a}_z$ V/m. Determine the polarization of the wave.

Part-III

Only Long Answer Type Questions (Answer Any Two out of Four)

Q3 For electromagnetic fields to exist in a linear, homogeneous, isotropic, surfaces-free conduction region, show that the $\vec{E}$ field must satisfy the following equation: $\nabla^2 \vec{E} - \mu\varepsilon \frac{\partial^2 \vec{E}}{\partial t^2} - \mu\sigma \frac{\partial \vec{E}}{\partial t} = 0$. **(16)**

Q4 Define the divergence of a vector. What do you mean by a positive divergence and negative divergence of a vector? Formulate the divergence of electric flux leaving from a volume in Cartesian, Cylindrical and spherical coordinates. **(16)**

Q5 Define the displacement current density. Differentiate between the displacement current and conduction current. Derive the expression for displacement current density from Ampere's circuital law. Relate the Stoke's theorem to this Ampere's circuital law. **(16)**

Q6 Explain the polarization of a wave. What is the major difference between an elliptically and circularly polarized wave? **(16)**

A uniform plane wave with an $\vec{E} = 12\cos(\omega t - \beta z)\vec{a}_x - 5\sin(\omega t - \beta z)a_y$ V/m is propagating in a lossless medium $\mu_r = 1$, $\varepsilon_r = 2.5$ at 200 Mrad/sec. Determine the corresponding

i) the phase constant β
ii) the phase velocity
iii) wave length
iv) loss tangent
v) H field
vi) Intrinsic impedance.
vii) The polarization of the wave.