| **Paper Code: EC-404** | **Roll No.** | | | | | | | | | | |
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# B.Tech.
## (SEM IV) EVEN SEMESTER EXAMINATION, 2015-16
## ELECTROMAGNETIC FIELD THEORY

**[Time: 2 hrs.]** **[Max. Marks: 50]**

**1.** Attempt any FOUR of the following:- **[3.5x4=14]**

(a) Two points are given as P (2, -1, -3) and Q (1, 3, 4). Give the vector that extends from P to Q in (i) Cartesian coordinates (ii) cylindrical coordinates.
(b) Find the gradient of the following scalar field:
  (i) $U= \rho^2 z \cos 2\phi$
  (ii) $V=10r\sin^2\theta\cos\phi$
(c) Explain the physical significance of divergence, gradient and curl.
(d) A charge $Q_0$, located at the origin in free space, produces a field for which $E_Z$ = 1kV/m at point P (-2, 1,-1). (i) Find $Q_0$,(ii) Find E, at M (1, 6, 5).
(e) What is Gauss's law? Give the applications of Gauss's law.
(f) Within the cylinder $\rho=2$, $0<z<1$, the potential is given by $V= 100+50\rho+150\rho \sin\varphi$ V.
  (i) Find V, E, D and $\rho_v$ at P($1,60^0,0.5$) in free space .
  (ii) How much charge lies within the cylinder?

**2.** Attempt any Two parts of the following:- **[6x2=12]**

(a) Derive an expression for continuity equation and relaxation time.
(b) Drive the expression for the capacitance of a coaxial capacitor. Two conducting spherical shells have radii a=3cm and b=6cm. The interior is a perfect dielectric for which $\varepsilon_r$ =8, calculate its capacitance.
(c) Describe the boundary condition in electrostatic field for (i) dielectric-dielectric (ii) conductor –dielectric (iii) conductor -free space boundary conditions.

**3.** Attempt any TWO of the following:- **[6x2=12]**

(a) Describe biot-savart's law. A circular loop located on $x^2+y^2= 9$, z=0 plane and carries a direct current of 10A along $a_\varphi$direction. Determine H at (0, 0, 4) and (0, 0, -4).
(b) Describe the magnetic boundary condition. Given that $H=24a_x-30a_y+40a_z$kA/m in region 1, Z>0 with $\mu_r$=50. If z=0 separates regions 1 and 2 and carries $6a_x$ kA/m, determine the magnetic flux density in region 2, z<0, with $\mu_r$=100.
(c) State and explain Maxwell's equation in both differential and integral form for time varying field and also discuss its physical significance.

**4.** Attempt any TWO of the following:- **[6x2=12]**

(a) Derive the wave equation for free space. For a lossy dielectric material having $\mu_r$=1, $\varepsilon_r$ =40, $\sigma$= 20 S/m, calculate attenuation constant, phase shift and intrinsic impedance at a frequency of 9GHz.
(b) What is pointing vector? Discuss the pointing theorem and explain the physical meaning of each integral involved there in.
(c) The magnetic field component of an EM wave propagating through a nonmagnetic medium ($\mu = \mu_0$) is $H= 25 \sin(2\times10^8t +6x)a_y$ mA/m determine:
  (i) The direction of wave propagation
  (ii) The permittivity of the medium.
  (iii) The electric field intensity.