Roll No.										

Paper Code: EC-508

B. TECH.
FIFTH SEMESTER EXAMINATION, 2016-2017
FUNDAMENTALS OF E.M. THEORY

[Time: 2 Hours] [Total Marks: 50]

Note: Attempt *ALL* questions. Assume suitable data, if required. All question carry equal marks.

1. Attempt any TWO of the following:- **(5x2=10)**

(a) Prove that the electric field E is equal to the negative gradient of the electric potential V ($E=-\nabla.V$).
(b) Derive the poission's equation in terms of divergence of the electric displacement and express it in generalized curvilinear coordinate system and also write expression in rectangular, cylindrical and spherical systems.
(c) Express vector $B = 10/r\, a_r + r\cos\theta a_\theta + a_\phi$ in Cartesian coordinates. Given point P(-2,6,3) and vector $A = ya_x + (x+z)a_y$. Express P and in spherical system.

2. Attempt any TWO of the following:- **(5x2=10)**

(a) State and explain the divergence theorem. Given $A = 5a_x - 2\,a_y + a_z$, find the expression of a unit vector B such that $B \parallel A$.
(b) State and explain the Stokes theorem. If the current density $J=1/r^2(\cos\theta a_r + \text{sinc}\theta a_\theta)$. A/m^2, find the current passing through a sphere radius of 1.0 m.
(c) State and explain the coulomb's law. A sphere of volume 0.1 m^3 has a charge density of 8.0pc/m^3. Find the electric field at a point (2, 0, 0) if the center of the sphere is at (0, 0, 0).

3. Attempt any TWO of the following:- **(5x2=10)**

(a) What is the area of plates required for constructing a parallel plate capacitor of capacitance 100pF using two plates with mica spacer (ε_r=5.4) that separates the plates by a distance of 10^{-2}cm.
(b) Show that a circular loop of wire carrying a direct current can be considered as a magnetic dipole of moment equal to the area times the current of the coil in analogy with an electric dipole.
(c) State and explain the Bio-Savart law. What is the magnetic field, H in Cartesian coordinates due to z-directed current element? Find J if I =2A.

4. Attempt any TWO of the following:- **(5x2=10)**

(a) State and explain the Maxwell's equation in time varying form. Show that the magnitude of force per unit area (pressure) acting on the each plate of a parallel-plate capacitor is the same as the energy density stored in the static electric field of the capacitor

(b) What are uniform plane waves? Explain. Derive a relation between electric field intensity and magnetic field strength in an uniform plane wave. A long straight copper wire and a long straight iron wire each carry the same current I in uniform B-field B_o. Show that the force on the iron wire is nearly twice the force on the copper wire.

(c) Define phase velocity, group velocity, propagation constant and phase-shift constant. Also derive the expression for phase shift constant for a conducting medium.

5. Attempt any TWO of the following:- **(5x2=10)**

(a) A circular loop of radius 0.15 m and resistance 10 ohm is immersed in a magnetic field of uniform flux density of magnitude $B=0.25\sin 10^3 t a_z$ T perpendicular to the plane of the loop. Find the current through the loop.

(b) What are the different types of transmission lines? In what ways do their applications differ? Define the characteristic impedance of a transmission line. Derive the expression for Input impedance of the lossless transmission line.

(c) Define and explain the meaning of the term standing –wave-ratio. What is the formula for it if the load is purely resistive? Why is a high value of SWR often undesirable? Discuss the importance of Smith Chart in calculating transmission line parameters.