Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

FOURTH SEMESTER B. TECH (E & C) DEGREE END SEMESTER EXAMINATION
MAY/JUNE 2016
SUBJECT: ELECTROMAGNETIC WAVES (ECE - 208)

TIME: 3 HOURS **MAX. MARKS: 50**

Instructions to candidates
- Answer **ANY FIVE** full questions.
- Missing data may be suitably assumed.

1A. Define Electric field intensity **E**. Derive expression for **E** at any point in free space due to an infinite line charge ρ_L C/m placed along z-axis.

1B. Obtain the equivalent of vector $\mathbf{F} = 4\mathbf{a_x} - 2\mathbf{a_y} - 4\mathbf{a_z}$ in cylindrical coordinate at point A($\rho = 5$, $\varphi = 59^o$, $z = 5$).

1C. Define electric flux density and state Gauss law.

(5+3+2)

2A. Define Gauss Divergence theorem and verify this theorem by evaluating both sides of the equation for the following case.

$\mathbf{D} = 6\,\rho \sin(\varphi/2)\ \mathbf{a_\rho} + 1.5\,\rho \cos(\varphi/2)\ \mathbf{a_\varphi}$ C/m^2 ; $1 \le \rho \le 2$, $0 \le \varphi \le \pi/2$, $0 \le z \le 5$.

2B. Derive expressions for the potential and electric field due to electric dipole at a point radial distant ***r*** from the dipole.

2C. Write the electric field boundary conditions for dielectric – dielectric interface.

(5+3+2)

3A. Two identical conducting planes of area *S* are separated by small distance *d* and placed in a dielectric medium of permittivity ε. A potential difference V_o volt exists between the plates. Using Laplace equation, obtain an expression for the capacitance.

3B. What is relaxation time? Obtain an expression for the same.

3C. If a potential field $V = (60/r^2)\sin(\theta)$ volt exists in free space, then the electric field at P(3m,60^o,25^o) will be -----

(5+3+2)

4A. A circular loop of radius *a* carries current *I* in anti-clockwise direction. Derive an expression for the magnetic field intensity at appoint along the axis of the loop distant *d* from the centre.

4B. A solid circular conductor of radius a carries current *I*. Use Ampere law to obtain the distribution of magnetic field intensity inside and outside the conductor.

4C. Define scalar and vector magnetic potentials.

(5+3+2)

5A. Derive an expression for torque on a current carrying loop of area *S* immersed in an uniform magnetic field **B**.

5B. A conducting wire along x-axis carries a current 20A in $\mathbf{a_x}$ direction. It is in a magnetic field $\mathbf{B}$ = 10 $\mathbf{a_x}$ + 5 $\mathbf{a_y}$ Wb/m^2. Determine force per meter length of the wire.

5C. Write either in integral or in point-form Maxwell equations for free space.

(5+3+2)

6A. Derive expressions for reflection coefficient Γ and transmission coefficient τ for a plane wave travelling from one dielectric medium to other with normal incidence at the interface.

6B. A plane wave at 9.375 GHz propagates in a loss less dielectric medium with $\epsilon_r = 2.26$. If $E_{x0} = 500$ V/m, determine propagation constant and H_{y0}.

6C. State Poynting vector theorem.

(5+3+2)