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. Derive expression for electric field intensity **E** and potential V at any point in free space due to an electric dipole.

1B. Obtain the equivalent of vector $\mathbf{F} = 20\,\mathbf{a}_\rho - 10\,\mathbf{a}_\varphi + 3\mathbf{a}_z$ in rectangular coordinate at point B(x = 5, y = 2, z = -1).

1C. State Gauss law and Gauss divergence theorem.

(5+3+2)

2A. Derive Electric field boundary conditions for dielectric-conductor and dielectric-dielectric interface.

2B. Line charge 2μC/m is along infinite z-axis in free space. Determine **E** field at point P(1,2,3) m.

2C. If flux density $\mathbf{D} = xy^2\mathbf{a}_x + yx^2\mathbf{a}_y + z\mathbf{a}_z$ C/m^2, then the charge density is --------.

(5+3+2)

3A. Write Poisson and Laplace equations. Using solution to Laplace equation, derive expressions for potential variation inside and outside a hollow cylinder of radius *a* held at a potential V_0.

3B. Determine the energy stored in hemisphere region $r < 2$m, $0 < \theta < \pi$ and $0 < \varphi < \pi$ where an electric field $\mathbf{E} = 2r\sin(\theta)\cos(\varphi)\,\mathbf{a}_r$ V/m exists.

3C. The relaxation time for the fused quartz whose $\varepsilon_r = 4.5$ and $\sigma = 10^{-17}$ S/m is -------- days

(5+3+2)

4A. Derive an expression for magnetic field intensity at any point due to infinite line conductor carrying current *I*.

4B. Define Ampere Law. Using this, obtain an expression for magnetic field intensity in the space between two conductors of co-axial cable.

4C. A charge Q is moving with velocity v in a magnetic field. What is the force exerted on this? Mention the direction of this force.

(5+3+2)

5A. Define Stokes theorem and verify this theorem by evaluating both sides of the equation for the rectangular path in anti-clockwise direction defined by $2 \le x \le 5$, $-1 \le y \le 1$, $z = 0$.

$\mathbf{H} = 6xy\,\mathbf{a}_x - 3y^2\,\mathbf{a}_y$ A/m.

5B. Two identical circular loops of radius *a* are separated by a small distance *d*. Current *I* flows in each

loop but in opposite direction. Assuming $d << a$, determine the force between the loops.

5C. Write the magnetic field boundary conditions.

(5+3+2)

6A. Starting from Maxwell equations, derive wave equation for uniform plane wave propagating in free space.

6B. A plane wave at 3 MHz propagates in a non-magnetic medium with $\epsilon_r = 3.2$ and $\sigma = 1.5 \times 10^{-4}$ S/m. determine loss tangent, propagation constant, attenuation constant and intrinsic impedance.

6C. Define critical angle and Brewster angle.

(5+3+2)