Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

THIRD SEMESTER B.TECH (E & C) DEGREE END SEMESTER EXAMINATION
NOV/DEC 2015
SUBJECT: ELECTROMAGNETIC WAVES [ECE 2102]

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

Instructions to candidates
- Answer **ALL** questions.
- Missing data may be suitably assumed.

1A. The volume charge density $\rho_v = \rho_0/r^2$ C/m^3; $a \le \rho \le b$ exists between two concentric spheres of radii *a* and *b*. Determine **E** and V everywhere.

1B. Finite length line charge 10 μC/m extends from z = -5 to z = 5m. Determine Electric field **E** at a point (0,5,0)m in free space

1C. The distance between the points A(5cm,30^0,4cm) and B(6cm,-30^0,8cm) is ----

(5+3+2)

2A. Verify the divergence theorem for the field $\mathbf{D} = r^2\mathbf{a_r} + r\sin(\theta)\cos(\varphi)\mathbf{a_\theta}$ C/m^2 over the surface defined by $0 < r < 3,\ 0 < \varphi < \pi/2,\ 0 < \theta < \pi/2$

2B. State and explain the boundary conditions for electric field.

2C. Let the electric dipole $\mathbf{p}=5\mathbf{a_x}+3\mathbf{a_y}$ nC.m and $\mathbf{a_r} = (-3\mathbf{a_x}+4\mathbf{a_y})/5$. The potential V at a point 5cm from the dipole in free space = -----

(5+3+2)

3A. If $\mathbf{H} = 2\rho z\mathbf{a_\rho} + 3z\sin(\varphi)\mathbf{a_\varphi} - 4\rho\cos(\varphi)\mathbf{a_z}$ A/m, verify Stoke's theorem for the open surface defined by $z = 1,\ 0 < \rho < 2,\ 0 < \varphi < 45^0$.

3B. Determine **H** field at a point along the axis of a loop of radius *a* carrying current **I** in clockwise direction.

3C. The convection current density for $\rho_v = 5$nC/m^3 moving with a velocity $\mathbf{v}=5\times10^6\mathbf{a_z}$ m/sec is --

(5+3+2)

4A. A uniform plane wave with sinusoidal time variation at frequency f = 850 MHz propagates in a lossy dielectric medium in positive z direction. The medium has σ = 4S/m, $\varepsilon_r = 80$ and $\mu_r = 1$. If the electric field $|\mathbf{E_x}| = 150$V/m, determine propagation constant, attenuation constant, phase constant, phase velocity, intrinsic impedance and $|\mathbf{H_y}|$.

4B. Derive an expression for torque on a closed loop of area S carrying current **I** placed in uniform magnetic field **B**.

4C. The instantaneous Electric field of uniform plane wave propagating in lossless dielectric with ε_r = 81 is $E_x(z,t) = 100 \cos(2 \pi X10^6 t - 0.19z)$. Then the average power density at z = 10 m is -----

(5+3+2)

5A. With neat diagram, derive expressions for reflection coefficient and transmission coefficient for a parallel polarized plane wave travelling from one dielectric medium to other with an oblique incident angle θ at the interface.

5B. Derive the general wave equation in free space and its solution in **E** field from Maxwell's equations.

5C. Uniform Plane wave in free space when incident on the surface of unknown medium sets up standing wave with SWR = 5, distance of first maximum = 1.5m from the surface and distance between successive maxima = 3m. Then the intrinsic impedance of unknown medium is --------

(5+3+2)