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. Solid sphere of radius *a* is uniformly charged to charge density ρ_v C/m^3. Determine **E** and V everywhere.

1B. Derive an expression for E field due to an infinite line charge ρ_L C/m lying along z-axis.

1C. The vector in spherical coordinate system equivalent to $\mathbf{A} = 2\mathbf{a_x}$ at P(1,0,1) is ----

(5+3+2)

2A. Verify the divergence theorem for the field $\mathbf{D} = 6\rho\sin(\varphi/2)\mathbf{a_\rho} + 1.5\rho\cos(\varphi/2)\mathbf{a_\varphi}$ C/m^2 over the surface defined by $\rho = 2,\ 0 < \varphi < \pi/2,\ 0 < z < 5$

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

2C. The work done in moving 2 mC point charge from point A(1,0,0) to point B(0,3,0) along the path y = 3 - 3x and z = 0 in an Electric field $\mathbf{E} = x\mathbf{a_x} + 2y\mathbf{a_y}$ is -----

(5+3+2)

3A. If $\mathbf{H} = 3xy\ \mathbf{a_x} - 2y^2\ \mathbf{a_y}$ A/m, verify Stoke's theorem for the anticlockwise closed path defined by z=0, 1 < x < 5, -2 < y < 2.

3B. Determine **H** field due to infinite line conductor along z-axis carrying current I in $\mathbf{a_z}$ direction.

3C. The relaxation time for the fused quartz whose $\varepsilon_r = 5$ and $\sigma = 10^{-17}$ S/m is -------- days.

(5+3+2)

4A. Uniform plane wave frequency f = 9.75 MHz and E_{x0} = 500 V/m propagates in a dielectric medium in positive z direction. The medium parameters are $\varepsilon_r = 2.26$, $\sigma = 5\text{x}10^{-2}$ S/m, $\mu_r = 1$. Determine propagation constant, attenuation constant, phase constant, phase velocity, intrinsic impedance and H_{y0}.

4B. Derive boundary conditions for magnetic field.

4C. Solid conductor of circular cross-section with radius 2mm carries uniformly distributed current $10\mathbf{a_z}$ A. Determine H_φ inside the conductor at ρ = 1mm.

(5+3+2)

5A. With neat diagram, derive expressions for reflection coefficient and transmission coefficient for a plane wave travelling from one dielectric medium to other with normal incidence at the interface.

5B. Write the Maxwell's equations in point form. Using these equations, derive the general wave equation in free space for **E** field.

5C. TM polarized EM wave is incident on the interface separating two media with relative permittivity $\varepsilon_{r1} = 2$ and $\varepsilon_{r2} = 3$. Then the Brewster angle for total transmission is -------- degrees.

(5+3+2)