Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
Manipal University

THIRD SEMESTER B.TECH (E & C) DEGREE END SEMESTER EXAMINATION - NOV/DEC 2016

SUBJECT: ELECTROMAGNETIC WAVES (ECE - 2102)

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

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

1A. Derive an expression for the electric field of a line charge distribution of infinite length.

1B. Given three points $A(4, 3, 2)$, $B(-2, 0, 5)$, and $C(7,-2, 1)$, *i*) Specify the vector **A** extending from the origin to the point *A*, *ii*) Calculate the perimeter of triangle *ABC*.

1C. A vector of magnitude 10 is directed from $(5, 5\pi/4, 0)$ in cylindrical coordinates toward the origin. Express the vector in Cartesian coordinates. (5+ 3+2)

2A. A point charge at (1,-1,-3)m of charge 300μC experiences a force of $\mathbf{F} = 8\mathbf{a}_x - 8\mathbf{a}_y + 4\mathbf{a}_z$ N due to a charge *Q* at (3,-3,-2)m. Determine *Q*.

2B. Determine total charge within a sphere of radius 4m if volume charge density $\rho_v = 10/(r\sin\theta)$ C/m^3

2C. Show that if $\mathbf{D} = (100/\rho)\mathbf{a}_\phi + 40\mathbf{a}_z$ in a certain region then there is no free charges in that region.

(5+3+2)

3A. Given $\mathbf{D} = 30x\mathbf{a}_x - 2z\mathbf{a}_z$, evaluate both sides of the divergence theorem for the region defined by -1<x<1, 1<y<1 and -1<z<1

3B. i) State Gauss's law ii) Discuss the divergence theorem.

3C. If the conduction current density in a lossy dielectric as 0.02 sin $(10^9 t)$ A/m^2, determine the displacement current density if the conductivity is 10^3 S/m and relative permittivity is 6.5. (5+3+2)

4A. Starting from the concept of reflection and refraction of plane waves at an interface, derive an expression for the Brewster angle.

4B. State the Maxwell's equations in point form and using appropriate theorems, convert them into the integral form.

4C. Given $\mathbf{D} = -4\mathbf{a}_y + 1.5\mathbf{a}_z$ C/m^3 in free space ($x > 0$), calculate **P** in the dielectric ($x < 0$), with $\varepsilon_r = 5$.

(5+3+2)

5A. A linearly polarized sinusoidal plane wave is incident from region-1 normal to the interface separating this region from another region-2. Region-1 is perfect dielectric and region-2 is perfect conductor. Derive expressions for total Electric and magnetic fields in region-1.

5B. A parallel polarized (p-polarized) EM wave is incident at oblique angle on the interface separating two perfect dielectric media. Derive expression for reflection coefficient.

5C. What is Poynting vector? In free space, $\mathbf{E}(z,t) = 50\cos(\omega t - \beta z)\boldsymbol{a}_x$ V/m. Find the average power crossing a circular area of radius 2.5 m in the plane z = constant. (5+3+2)