Reg. No.										

MANIPAL INSTITUTE OF TECHNOLOGY
MANIPAL
A Constituent Institution of Manipal University

THIRD SEMESTER B. Tech. (E & C) DEGREE END SEMESTER EXAMINATION
NOV 2017
SUBJECT: ELECTROMAGNETIC WAVES (ECE - 2102)

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

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

1A. State and Prove Gauss divergence theorem.

1B. Consider a lossy dielectric medium with $\varepsilon = 8\varepsilon_0$, $\mu = \mu_0$ and $\sigma = 5\times10^{-4}$ S/m. If a plane wave propagates with a frequency 60 MHz in this medium, calculate $\alpha, \beta, \upsilon_{ph}$ and η.

1C. (i) Calculate the phase velocity of a propagating wave in a conducting medium with $\mu = \mu_0$ and $\sigma = 5.8\times10^7$ S/m at f = 100 MHz.

(ii) Calculate the standing wave ratio if $E_{incident} = 5V/m$ and $E_{reflected} = 0.5V/m$.

(5+3+2)

2A. Derive an expression for the torque due to a closed current carrying square loop in a magnetic field.

2B. A current element of length 20 cm is located at the origin in free space and carries current of 5mA along $\vec{a}_x$. A filamentary current of 10 $\vec{a}_z$ A is located at x = 4 cm and y = 6 cm. Find the force on the current filament.

2C. (i) Find the amplitude of displacement current density if $\vec{E} = 0.5\cos[314.16t - \beta z]\vec{a}_x V/m$, and $\epsilon_r = 6$.

(ii) If H_0 = 5 mA/m in a homogenous medium with $\epsilon_r = 8$, $\mu_r = 2$ and $\sigma = 0$ then the Poynting vector is …….W/m^2.

(5+3+2)

3A. Calculate the electric field intensity $\vec{E}$ at a distance ρ from an infinite line charge of ρ_l C/m charge density placed along the z axis.

3B. A thin ring of radius 10 cm is placed on plane z = 2 cm with its center is a t (0, 0, 2 cm). If the ring carries 100 mA current along $\vec{a}_e$ find $\vec{H}$ *and* $\vec{B}$ at (0, 0, 10 cm) in free space.

3C. (i) If $\rho = 5nC/m^3$ and velocity $\vec{v} = (5\vec{a}_x + 6\vec{a}_y - 3\vec{a}_z)\times10^8\, m/\sec$ then find the magnitude of the convection current density.

(ii) Find the energy density for $\vec{E} = 5\vec{a}_x - 6\vec{a}_y + 8\vec{a}_z V/m$ in a dielectric medium with $\epsilon_r = 6$.

(5+3+2)

4A. Starting from Maxwell's equations, derive the wave equation and obtain its solution in a conducting medium.

4B. Consider a region 1 (x < 0) which has a homogenous dielectric with ϵ_r=3.5 and a region 2 (x > 0) which has a homogenous dielectric with ϵ_r= 6.5. If $\vec{D}_1 = 15\vec{a}_x - 10\vec{a}_y + 5\vec{a}_z \ \mu C/m^2$, find $\vec{E}_2$, θ_1 and θ_2, where the angles are defined with respect to the normal to the interface.

4C. (i) What is the potential difference between two points specified by $15\vec{a}_x - 19\vec{a}_y + 5\vec{a}_z$ m if field $\vec{E} = 4\vec{a}_x - 3\vec{a}_y + 2\vec{a}_z \, V/m$?

(ii) Find the relaxation time of mica with $\sigma = 10^{-15} S/m$ and $\epsilon_r = 6$.

(5+3+2)

5A. Derive expressions for reflection and transmission coefficients when a plane wave is incident normally on an interface between two different media.

5B. A circular ring of radius 5 cm carries a uniform line charge of $\rho_l = 10 \, \mu C/m$ and is placed on the *xy*-plane with its centre at the origin. Calculate $\vec{E}$ and *V* at P (0, 0, 6 cm).

5C. (i) Find the distance between the points A (5, 30^0, 45^0) and B (12, 40^0, 75^0).

(ii) Convert point P (5, 4, 8) in to cylindrical coordinates.

(5+3+2)