MANIPAL ACADEMY of HIGHER EDUCATION
(Deemed to be University under Section 3 of the UGC Act, 1956)

Reg. No.										

DEPARTMENT OF SCIENCES, III SEMESTER M.Sc (Physics)
END SEMESTER EXAMINATIONS, NOVEMBER 2018

SUBJECT: ELECTROMAGNETISM [CODE- 5103]
(REVISED CREDIT SYSTEM-2017)

Time: 3 Hours Date: 22 November 2018 MAX. MARKS: 50

Note: (i) Answer **ALL** questions
(ii) Draw diagrams, and write equations wherever necessary

1. (a) Derive Poisson's equation and hence deduce Laplace's equation. Demonstrate how Laplace's equation can be solved for a one dimensional case.
(b) Derive the expression for scalar potential of a polarized object.
(c) Using Biot-Savart law, derive the expression for divergence and curl of magnetic field. **[4+2+4]**

2. (a) Using the concept of multipole expansion, derive the expression for vector potential due to a localized current distribution.
(b) Find the electric field a distance ***z*** above the center of a circular loop of radius **r** which carries a uniform line charge $\boldsymbol{\lambda}$.
(c) Derive the expression for energy of a dipole in an electric field. **[5+2+3]**

3. (a) Derive the expression for energy stored in the magnetic field.
(b) A cylindrical wire of cross sectional area ***A*** and length ***L*** is made of materials with conductivity $\boldsymbol{\sigma}$. If the potential difference between the ends is ***V***, what current flows through the wire?
(c) State and prove Poynting's theorem. **[4+2+4]**

[P.T.O]

4. (a) Consider a plane wave of frequency $\boldsymbol{\omega}$, traveling in the x-direction and polarized in **y**-direction and is approaching the interface from the left. Derive the expressions for reflected and transmitted waves. Also derive expressions for the reflection and transmission coefficients.

   (b) In the context of dispersion in non-conductors, derive the expression for complex permittivity. **[5+5]**

5. (a) Derive Lienard- Wiechert potentials.

   (b) Consider two tiny metal spheres separated by a distance $\boldsymbol{a}$ and connected by a fine wire. This configuration is driven by a sinusoidal current, at frequency $\boldsymbol{\omega}$. Derive the expressions for electric and magnetic fields. **[4+6]**