MANIPAL
ACADEMY of HIGHER EDUCATION

Reg. No.										

DEPARTMENT OF SCIENCES, I/III SEMESTER M.Sc (Physics)
END SEMESTER EXAMINATIONS, DECEMBER 2020

ELECTROMAGNETIC THEORY [PHY- 5103]

(REVISED CREDIT SYSTEM-2017)

Time: 3 Hours **Date: 31/12/2020** **MAX. MARKS: 50**

Note: (i) Answer **ALL** questions

(ii) Assume missing data, if any

1. (a) Distinguish between Poisson's equation and Laplace's equation.

   (b) Find the electric field produced by a uniformly polarized sphere of radius R.

   (c) Derive the expressions for divergence and curl of electrostatic fields. **[2+4+4]**

2. (a) Consider a localized charge distribution. Using the method of multipole expansion, derive the expression for scalar potential at distant points.

   (b) Derive Gauss's law in presence of dielectrics.

   (c) A metal sphere of radius a carries a charge Q. It is surrounded, out to radius b, by a linear dielectric material of permittivity ϵ. Find the potential at the centre relative to infinity.

   [4+2+4]

3. (a) Discuss how one can introduce the concept of magnetic vector potential in magnetostatics.

   (b) Quantitatively discuss the effect of magnetic fields on atomic orbits

   (c) Derive Neumann's formula for inductance. **[3+4+ 3]**

4. (a) State and derive Poynting's theorem

   (b) A plane wave of frequency ω traveling in x-direction and polarized in y-direction, approaches the yz plane. Derive the expression for reflection coefficient. **[5+5]**

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5. (a) Starting from the expression of polarization, derive Cauchy's equation.

(b) Consider a wire loop of radius a, around which we drive a sinusoidally varying current, at frequency ω. Derive the expression for magnetic flux for magnetic dipole radiation. **[5+5]**