(*iv*) The electric potential of some configuration is given by the expression

$$V(r) = A\frac{e^{-\lambda r}}{r}$$

where A and λ are constants. Find the electric field $E(r)$.

(*v*) What is displacement current ? How is it different from real current ?

(*vi*) Find the self inductance of a toroidal coil with rectangular cross-section with inner radius '*a*', outer radius '*b*' height '*h*' carrying a total of *N* turns.

(*vii*) What is self inductance ? Write its SI Unit.

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

(*ix*) The inequality

$$\oint_S \vec{J}\cdot\hat{n}da = -\frac{d}{dt}\int \rho d^3r$$

represents which conservation law. Give its statement.

(*x*) What is the Maxwell's correction to Ampère's law ?

2. What is magnetic vector potential ? Derive an approximate formula for the vector potential of a localized current distribution using multiple expansion. Find the vector potential of an infinite solenoid with '*n*' turns per unit length, radius *R* and current *I*. 6 + 4

3. What are Poisson's equation and Laplace equation ? Determine the solution of Laplace equation for spherical objects with azimuthal symmetry. Derive the potential on the surface of a sphere of radius R is $V_o(\theta)$. Find out the potential outside the sphere, assuming that there is no charge present at that point. 5 + 5

4. Derive an approximate expression of potential of an arbitrary localized charge distribution in powers $\frac{1}{r}$, where, r is the distance of the point in question from the charge distribution. Show