**Laplace and Poisson’s equations:**

Laplace's equation and Poisson's equation are fundamental equations in electrostatics, governing the behaviour of electric potentials in regions of space where there are no charges or where charges are distributed.

**Laplace's Equation**: Laplace's equation describes the behaviour of the electric potential (𝑉) in a region of space where there are no charges. Mathematically, it is expressed as:

∇2𝑉=0

Here, ∇2 is the Laplacian operator, which represents the divergence of the gradient of 𝑉. In simple terms, Laplace's equation states that the electric potential at any point in space is equal to the average of its neighbouring points. Solutions to Laplace's equation represent regions of constant potential, which are characteristic of conductors in electrostatic equilibrium.

**Poisson's Equation**: Poisson's equation describes the behaviour of the electric potential in a region of space where charges are distributed. Mathematically, it is expressed as:

∇2𝑉=−𝜌/𝜖0

Here, 𝜌 represents the charge density and 𝜖0​ is the permittivity of free space. Poisson's equation states that the Laplacian of the electric potential is proportional to the charge density. Solutions to Poisson's equation yield the electric potential in regions where charges are present, such as around conductors with non-uniform charge distributions.

In practical applications, Laplace's and Poisson's equations are used to determine the electric potential in various electrostatic systems. They are often solved using techniques such as separation of variables, Green's functions or numerical methods like finite difference or finite element methods. The solutions to these equations provide insights into the behaviour of electric fields and potentials, aiding in the design and analysis of devices such as capacitors, transmission lines and electrostatic shields.

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