''बेटी बचाओ, बेटी पढ़ाओ''

JAYOTI VIDYAPEETH WOMEN'S UNIVERSITY, JAIPUR

Faculty of Education & Methodology

Faculty Name - JV'n Ms. Harshpreet Cheema

Program - B.Sc. III Semester

Course Name - Electricity and Electromagnetism

Session No.& Name - 1. Electrostatic and Electric Current

Academic Day starts with –

- Greeting with saying **'Namaste'** by joining Hands together following by 2-3 Minutes Happy session, Celebrating birthday of any student of respective class and **National Anthem**.

Topic-2: Line, Surface and Volume Integrals

Integrals are mathematical calculations that allow us to compute the area, volume, or length of a curve or surface. The integral is computed by adding all of the little components that comprise the curve or surface. This can be done analytically (through calculus) or numerically (using a computer).Integrals are classified into three types: line, surface, and volume. Let's take a closer look at each one.

Line Integral

The length of a curve is calculated using a line integral. The sum of all the little bits that make up the curve is used to compute line integral. The symbol "∫" represents the line integral.

To compute a line integral, you must first have the curve's equation and the beginning point. The curve's equation is often expressed in terms of x and y coordinates. The starting point is just where you want to begin measuring the length of the curve.

Properties of Line Integral

1. Reversing the integration path alters the sign of the integral.
2. If the integration path is broken into smaller pieces, the sum of the distinct line integrals along each segment equals the line integral along the entire path.

Applications of Line Integral

The line integral has a variety of applications. The surface area in three-dimensional planes is calculated using a line integral. The following are some applications of line integrals in vector calculus:

1. The mass of wire is calculated using a line integral.
2. It aids in calculating the moment of inertia and the center of mass of the wire.
3. Ampere's Law uses it to calculate the magnetic field surrounding a conductor.
4. A line integral is used in Faraday's Law of Magnetic Induction to calculate the voltage created in a loop.
5. The work done by a force on a moving object in a vector field can be calculated using the line integral.

Surface Integral

A surface integral is similar to a line integral in that it measures the area of a surface rather than the length of a curve. A surface integral is represented by the symbol "∬". To compute the integral, we need to know the surface equation and the beginning point, much like with line integrals. The vector differential

dSrepresents a vector area element of the surface S, and may be written as dS = nˆ dS, where nˆ is a unit normal to the surface at the position of the element.

Application of Surface Integral

Surface integrals are used in many fields of science and engineering. The following are some applications of surface integrals in vector calculus:

1. Surface Integrals are used to calculate pressure and gravity.
2. It is used to compute the electric field in Gauss' Law of Electro statistics.
3. Determine the shell's mass.
4. It is used to compute the moment of inertia and the shell's center of mass.
5. It aids in determining the distribution of electric charge on the surface.

Volume Integral

The volume of a three-dimensional object is calculated using a volume integral. A volume integral is denoted by the sign "∫∫∫".

To determine the volume of an object, we must first know its equation and beginning point, much as we did with line and surface integrals.

Applications of Volume Integral

Volume integrals are very useful in physics for a variety of purposes

1. For calculating flux densities or mass from a corresponding density function.