ENGINEERING MATHEMATICS - I

Partial Differentiation

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ENGINEERING MATHEMATICS - I

UNIT 2 : Partial Differentiation

Session : 1

Sub Topic : Introduction

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Topics in the Module

- Definition, Total derivative and Chain Rule
- Partial differentiation of Composite and Implicit functions
- Euler's theorem
- Maxima and Minima for a function of two variables
- Lagrange's Method of Undetermined multipliers

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Introduction

- ✓ Why do we need a function of more than one variable?
- ✓ How do we calculate the limits, Continuity and differentiability of a function of more than one variable?
- ✓ Can we find relative extrema of functions using derivatives of multivariable functions?

Why do we need multivariable functions?

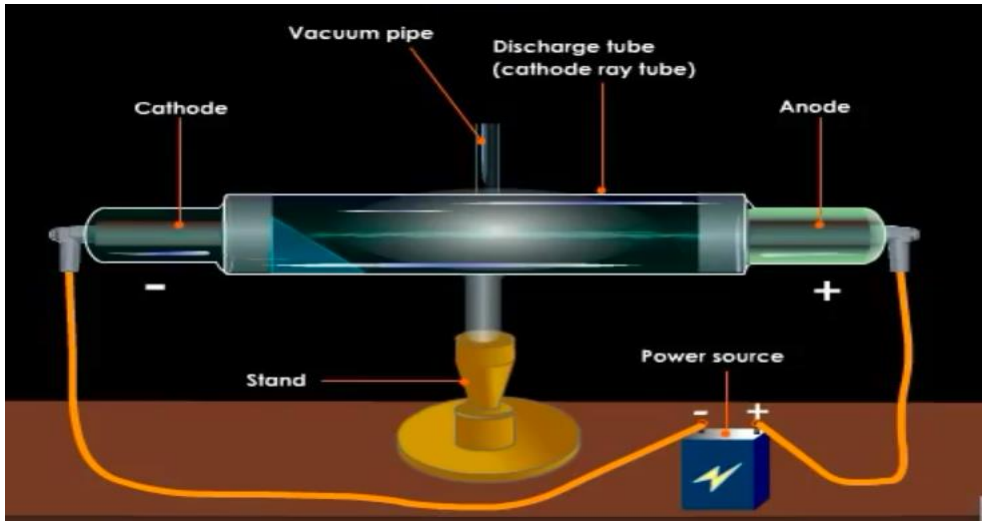
Quantities which depend on two or more variables are represented using functions with two or more variables.

Examples for functions of several variables:

1. The area (A) of a rectangle depends on its length (*l*) and breadth (b).

2. The volume (v) of a cylinder depends on its radius (r) and height (h).

3. Electrical potential V within a cathode ray tube vary with spatial positions and time.
i.e. $v = f(x, y, z, t)$



4. The Propagation of Electromagnetic wave depends on the Magnetic field, Electric field, Wavelength and the direction of propagation.

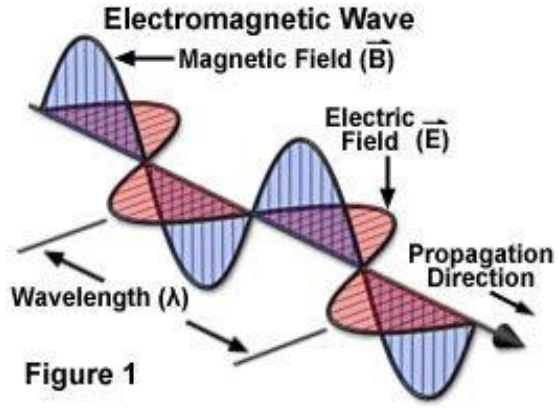


Figure 1

5. The Weather(v) of a region depends on Topography of the place, pressure, humidity and temperature distribution.

Introduction

6. To study the rate of spreading of a pandemic like COVID 19 which again depends on the area, population, awareness amongst the people in that area, immunity level of the people, distribution of the population based on their age group, gender and other classification.

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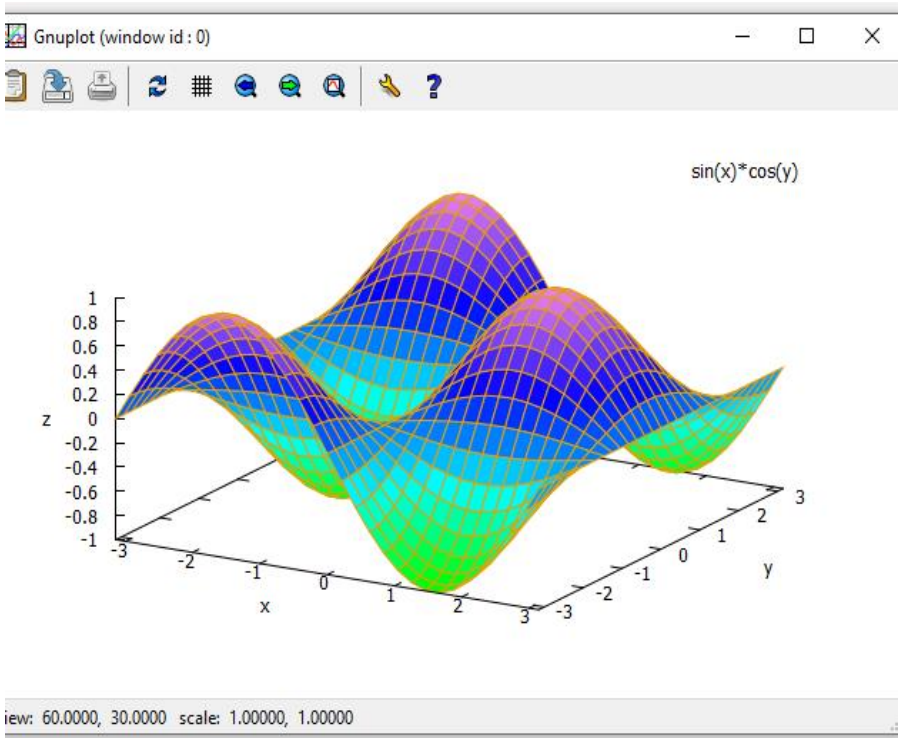
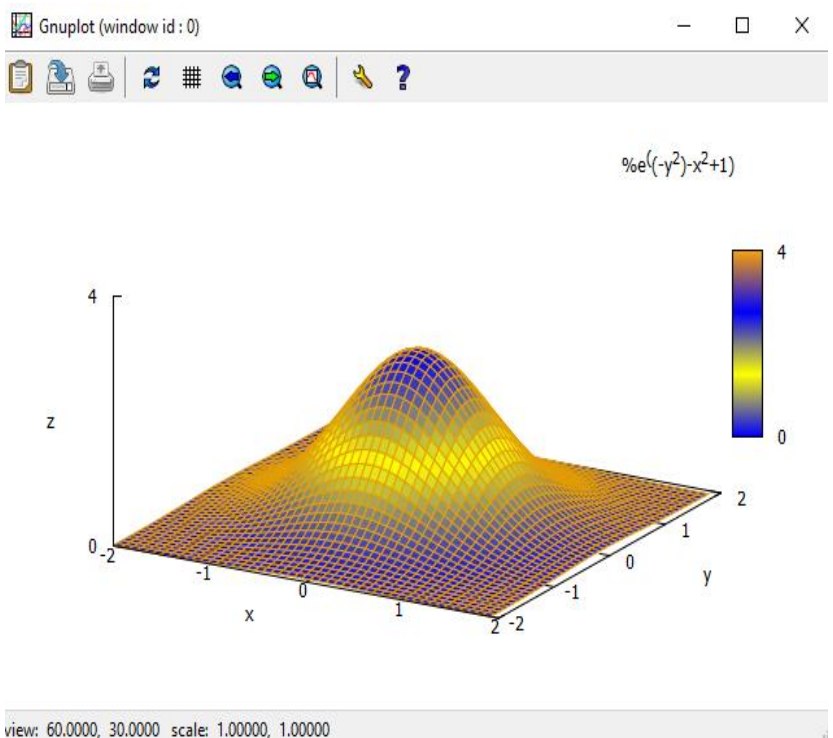
Functions of Two Independent Variables

- A function of two variables denoted by $z = f(x, y)$ is a rule that assigns to each ordered pair of real numbers (x, y) in a set D a unique real number denoted by $f(x, y)$. The set D is the domain of f and its range is the set of values that f takes on. $\{f(x, y), (x, y) \in D\}$





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Limit of a Function of Two Variables

- A function $f(x,y)$ is said to approach the limit L as (x,y) approaches to (a,b), if the limit remains the same along any path of (x,y) approaching to (a,b).

$$\lim_{(x,y)\to(a,b)} f(x,y) = L$$

- There is potentially an infiite number of paths to consider.

PROBLEMS ON FINDING THE LIMITS

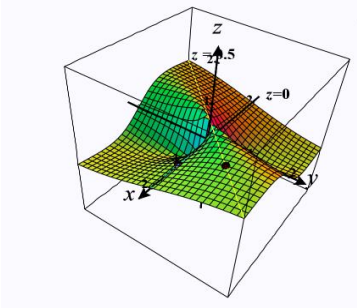
1. Evaluate the limit of the following function

$$\lim_{(x,y)\to(2,1)} (x^2 - 2xy + 3y^2 - 4x + 3y - 6)$$

Problems on Limits

2. Show that for the following function limit does not exist.

$$\lim_{(x,y)\to(0,0)} \frac{2xy}{3x^2+y^2}$$



Along the line $y = 0$, the value of the limit Is zero, whereas along $y = x$ the values is ½

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