{Improvement Subject}

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Ordinary Differential Equations :-

An equation contains only ordinary derivatives of one or more dependent variables of a single independent variable

For exp :-

$$\frac{dy}{dx} + 5y = e^x, \quad \left(\frac{dx}{dt}\right) + \frac{(dy)}{dt} = 2x + y$$

An ordinary differential equation is an equation that contains one or several derivades of an unknown function. which we call $y(x)$ and which we want to determine from the equation. The equation may also contain y itself as well as given functions & Constants.

For example:

(1) $y' = \cos x$

(2) $y'' + 4y = 0,$

(3) $x^2 y''' y' + 2e^x y'' = (x^2+2)y^2$

Applications of ODE :-

→ Modelling with First-Order Equations
  * Newton's Law of Cooling
  * Electrical Circuits

↳ Modelling Free Mechanical Oscillations
  * No Damping
  * Light Damping
  * Heavy Damping

↳ Modelling Forced Mechanically Oscillations

↳ Computer Exercise OR Activity.

Differential equations are of great importance in engineering and Science because many physical laws and relations appear mathematically in the form of differential equations, for reasons that will soon become apparent.

To begin with, let us consider a basic physical application that will illustrate the typical steps of modelling, that is, the steps that lead from the physical situation (physical system) to a mathematical formulation and solution, and to the physical interpretation of the result. This may be the easiest way of obtaining a first idea of the nature and purpose of differential equations and their applications.

Partial Differential Equations:-

An equation contains partial derivatives of one or more dependent variables of two or more independent variables.

For exp:

$$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial t^2} = 2\frac{\partial u}{\partial t} \qquad \frac{\partial u}{\partial y} = \frac{\partial v}{\partial x}$$

Types:

* Linear PDE
* Non-Linear PDE

Applications / Examples of PDE:-

PDE's are used to model many systems in many different fields of science and engineering.

Important Examples

- Laplace Equation
- Heat Equation
- Wave Equation

Order of PDE's:

The order of PDE's is the order of the highest partial derivative in the equation.

Example

$$\frac{\partial u}{\partial t} = \frac{\partial^2 u}{\partial x^2} \quad \text{(2nd order)}$$

$$\frac{\partial u}{\partial t} = \frac{\partial u}{\partial x} \quad \text{(1st order)}$$

$$\frac{\partial u}{\partial t} = \frac{\partial^3 u}{\partial x^3} + \sin x \quad \text{(3rd order)}$$

In mathematics, a partial DE is an equation which imposes relations between the various partial derivatives of a multivariable function. PDE's are ubiquitous in mathematically-oriented scientiffic fields, such as physics and engineering.