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DEFINITION

CONSTANT: Constant is a quantity whose value is fixed during the given discussion. Constant is just a value, a fixed value that does not change.

- **Numerical or absolute constant:** Always has a fixed value. Ex: $3,5,\sqrt{2}$
- **Arbitrary constant:** letters which represents fixed numerical values.

VARIABLE: Variables are the symbols or letters in math equations whose values can change.

- **Independent variables:** Which do not rely on other variables to find their values.
- **Dependent variables:** Which must rely on other independent variables to find their values.

Dependent variable $\frac{dy}{dx} = 1$ **Independent variable**

Differential Equations: An equation involving derivatives of one or more independent variables is called a differential equation.

EXAMPLE OF DIFFERENTIAL EQUATION:

$$\frac{dy}{dx} + y = 0 \ldots\ldots (1)$$

$$\frac{dy}{dt} + \frac{dy}{dt} = 5x \ldots\ldots (2)$$

$$\frac{\partial v}{\partial x} + \frac{\partial v}{\partial y} + \frac{\partial v}{\partial z} = 0 \ \ldots\ldots (3)$$

Differential Equation 2 Types:

- ODE – Ordinary Differential Equation ($\frac{d}{dx}$)
- PDE – Partial Differential Equation ($\frac{\partial}{\partial x}, \frac{\partial}{\partial y}$)

1.Ordinary Differential Equation: A differential equation involving ordinary derivatives of one or more dependent variables with respect to a single independent variable is called an Ordinary Differential Equation.

EXAMPLE: $\frac{d^2y}{dx^2} + xy(\frac{dy}{dx})^2$=0

The variable x is the single independent variable, and y is a dependent variable.

2.Partial Differential Equation: A differential equation involving partial derivatives of one or more dependent variables with respect to more than one independent variable is called a Partial Differential Equation.

EXAMPLE:$\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial x^2}$=0

There are three independent variables: x, y, and z; in this equation u is dependent.

- ***THE ORDER OF THE DIFFERENTIAL EQUATION:*** The order of the highest ordered derivative involved in a differential equation is called the order of the differential equation.
- ***DEGREE:*** The power of the highest order derivatives is called degree.

$$\frac{dy}{dx} + \left(\frac{d^2y}{dx^2}\right)^{100} + (\frac{d^3y}{dx^3})^2 + y = 5$$

This is a 3rd order, 2nd degree ordinary differential equation

- ***LOW ORDER DEPENDENT VARIABLE:*** An equation involves no product of the dependent variables and or its derivatives or **transcendent** function of the dependent variables is called L.O.D.E(**Low order dependent variable**).

A function which represent a series is called **Transcendent function.**

$$e^x = 1 + \frac{x}{1!} + \frac{x^2}{2!} + \frac{x^3}{3!} + \cdots$$

LINEAR ORDINARY DIFFERENTIAL EQUATION: A linear ordinary differential equation of order n, in the dependent variable y and the independent variable x, is an equation that is in, or can be expressed in, the form

$$a_0(x)\frac{d^ny}{dx^2} + a_1(x)\frac{d^{n-1}y}{dx^{n-1}} + \cdots + a_{n-1}(x)\frac{dy}{dx} + a_n(x)y = b(x),$$

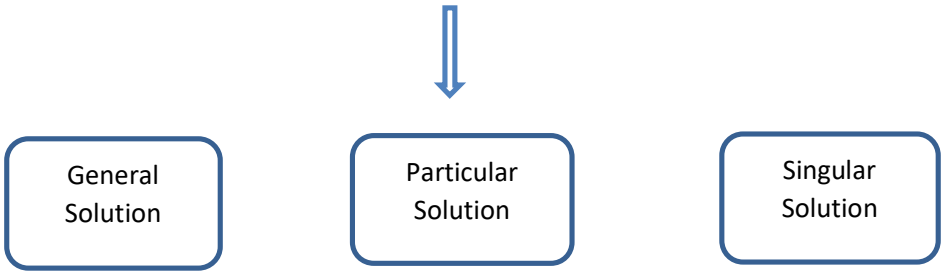
Where a_0 is not identically zero.

EXAMPLE: $\frac{d^2y}{dx^2} + 5\frac{dy}{dx} + 6y = 0$

NONLINEAR ORDINARY DIFFERENTIAL EQUATION: A nonlinear ordinary differential equation is an ordinary differential equation that is not linear.

EXAMPLE: $\frac{d^2y}{dx^2} + 5\frac{dy}{dx} + 6y^2 = 0$

SOLUTIONS



General Solution: Solutions obtained from integrating the differential equations are called general solutions. The general solution of a nth order ordinary differential equation contains n arbitrary constants resulting from integrating times.

Particular Solution: Particular Solutions are the solutions obtained by assigning specific values to the arbitrary constants in the general solutions.

Singular Solution: Solutions that can not be expressed by the general solutions are called singular solutions.