Mon Tue Wed Thu Fri Sat Sun

Date:

Differential Equations

$x^2+2x+1=0$ Algebric Equation (Polynomial Equation)

$\frac{dy}{dx}+x=0$ Differential Equation

$\frac{dy}{dx}+\sin x=0$ Differential Equation

$\sin x+x=0$ Trignometric Equation
or [Transidential Equation]

$x\,dy+y\,dx=0$ Differential Equation

$x+\frac{1}{x}=0$ Non-Polynomial

Definition

An equation involving derivatives or differentials of one or more dependent variables w.r.t one or more independent variables. is called Differential Equation.

Types

Ordinary Differential Equation

This D.E have derivatives with one/single Independent variables.

$$\frac{d^2y}{dx^2}+\frac{dy}{dx}+y=0$$

Same Independent variables.

Partial Differential Equation

This Differential Equation have derivatives w.r.t more than one Independent variables.

$$\frac{d^2v}{dx^2}+\frac{dv}{dt}=0$$

Different Independent variables

Differential Equations	Order	Degree
$\left(\frac{d^1}{dx}y\right)^1 + y = 0$ (Order ↑, Degree →)	1	1
$\left(\frac{d}{dx}y\right)^2 + y = 0$	1	2
$\frac{d^2y}{dx^2} + \frac{dy}{dx} + y = 0$	2	1
$\frac{d^2y}{dx^2} + \left(\frac{dy}{dx}\right)^3 + y = 0$	2	1

★ Highest Order Derivatives involves Degree of Differential Equation.

★ Degree of the Highest variable after the Differential Equation has been made free from Radical fractions.

Linear Differential Equations [L.D.E]

$\frac{dy}{dx} + y = 0$ (Dependent variable [D.V] → dy; Independent variable [I.V] → dx)

$[I.V] \leftarrow x \cdot \frac{dy}{dx} + y = 0$ (y → [D.V], $\frac{dy}{dx}$ → [I.V])

★ An Equation have maximum of only one degree.

★ No Products of Dependent variable and derivatives occurs.

Non-Linear Differential Equations [N.L.D.E]

$\left(\frac{d}{dx}\right)^2 + y = 0$

D.V ← $y \cdot \frac{d}{dx}y + y = 0$ (y → [D.V], $\frac{d}{dx}y$ → [I.V])

★ An Equation having maximum degree of 2 or more than 2.

★ Products of Dependent variable and derivatives occurs.

Mon Tue Wed Thu Fri Sat Sun

Date:

Autonomous Equation

$\frac{d}{dx}y = 1+y^2$

(D.V) is on Right side.

$\frac{d}{dx}y = y - y^2$

[D.V] is on Right side.

Non-Autonomous Equation

$\frac{d}{dx}y = 2xy$

[I.V] is on Right Side.

$\frac{d}{dx}y = x$

[I.V] is on Right side.

Difference between Homogeneous and non Homogeneous Differential Equations

Homogeneous D.E

- Term wise Power same
- R.H.S = 0

T.W.P=2, T.W.P=2, R.H.S = 0

$x^2 + 2xy' + y^2 = 0$

T.W.P=2, T.W.P=2, R.H.S = 0.

$x^2dy + y(x+y)dx = 0$

Term wise power are same and R.H.S is also equals to 0.

Non Homogeneous D.E

- Term wise Power same
- but R.H.S ≠ 0
- If R.H.S = 0 then Term wise power is not same
- Different term wise power and R.H.S ≠ 0

T.W.P=2, T.W.P=1, R.H.S=0

$x^2 + 2x = 0$

R.H.S ≠ 0

$\frac{d^2y}{dx^2} + \frac{d}{dx}y - 2y = 4x$

$$y = \sqrt{x}\left(\frac{dy}{dx}\right) + k/\frac{dy}{dx}$$

$$y - \sqrt{x}\left[\frac{d}{dx}y\right] = \frac{k}{\frac{dy}{dx}}$$

$$\frac{dy}{dx}\left[y - \sqrt{x}\left(\frac{dy}{dx}\right)\right] = k$$

$$k = y \cdot \frac{dy}{dx} - \sqrt{x}\left(\frac{d}{dx}y\right)^2$$

Differential Equation;
ordinary Differential Equation
Order = 1
Degree = 2.
Non-Linear Differential Equation

$$y = x\left(\frac{dy}{dx}\right) + a\left\{1 + \left(\frac{dy}{dx}\right)^2\right\}^{1/2}$$

$$\left[y - x\frac{dy}{dx}\right]^2 = \left[a\left\{1 + \left(\frac{dy}{dx}\right)^2\right\}^{1/2}\right]^2$$

$$y^2 + x^2\left(\frac{d^2y}{dx^2}\right)^2 - 2xy\frac{dy}{dx} = a^2\left[1 + \left(\frac{dy}{dx}\right)^2\right]$$

Differential Equation
Ordinary Differential Equation
Non-Linear Differential Equation
Order = 1
Degree = 2