

Lecture:- 12th

Date:- 07/04/22

## UNIT-VIth # Ordinary Differential Equation

Definition:- An equation involving dependent variable, independent variable and the differential coefficient of the dependent variable with respect of independent variable is known as - ordinary differential equation.

Ex:-  $\frac{d^2y}{dx^2} + y = 0$

• Order of ordinary differential equation:-

Order of highest order derivative occurring in ordinary differential equation is known as order of ODE.

• Degree in ordinary differential equation:-

Degree of a differential equation is the highest degree of highest order derivative. (After making derivative free from radical sign or fraction powers.)

Ex:- (1)  $\frac{d^2y}{dx^2} + \frac{dy}{dx} + y = 0$

then

order = 2  
degree = 1. } Ans.

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

then, order = 2 & degree = 3

(3)  $\frac{dy}{dx} + \sqrt{y} = 0$

then

order = 1 & degree = 1

(4)  $\left(\frac{dy}{dx}\right)^{1/3} + y = 0$

$\Rightarrow \frac{dy}{dx} = (-y)^3$

So, order = 1 & degree = 1.

(5)  $\sqrt{1+y'} = y''$

$\Rightarrow 1+y' = (y'')^2$

then  $\Rightarrow$  order = 2 & degree = 2.

(6)  $\sin(dy/dx) + y = 0$

$\Rightarrow \sin(dy/dx) = -y$

$\left(\frac{dy}{dx}\right) = \sin^{-1}(-y)$  then, order = 1 & degree = 1

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Question:- find order & degree of the following ODE:-

S.no	Equation	order	degree
(a)	$\frac{d^2y}{dx^2} + a^2x = 0$	2	1
(b)	$\left[1 + \left(\frac{dy}{dx}\right)^2\right]^{3/2} = \frac{d^2y}{dx^2}$	2	2
(c)	$x(y')^2 - yy' + 1 = 0$	1	2
(d)	$(y''')^4 - 6x^2(y')^8 = 0$	3	4
(e)	$y' = \sin y$	1	1
(f)	$\sin^{-1}(y') = x \Rightarrow \sin x = y'$	1	1
(g)	$\sqrt{1+2x^2} \cdot dx + \sqrt{1+2y^2} \cdot dy = 0$ $\Rightarrow (1+2x^2)dx + (1+2y^2)dy = 0$	1	1
(h)	$\sqrt{1+y'} = y'' \Rightarrow (1+y') = (y'')^2$	2	2
(i)	$yy'' + x^2y' + 4y = \cos x$	2	1
(j)	$\log_e \left(1 + \left(\frac{dy}{dx}\right)^3\right) = x$ $\Rightarrow 1 + \left(\frac{dy}{dx}\right)^3 = 1/x$	1	3