MJCPHY05   Unit :- 2 . Dr. Usha Kumari

Linear Ordinary Differential Equations of First and Second order :-

A differential equation is an equation involving derivatives of a dependent variable with respect to one or more independent variables.

e.g. $\dfrac{d^2y}{dx^2} + y = 0$, $x^2\dfrac{d^2y}{dx^2} + 4x\dfrac{dy}{dx} = e^x$

$\dfrac{\partial^2 z}{\partial x^2} + \dfrac{\partial^2 z}{\partial y^2} = x+y$ are   examples

of differential equations.

$\dfrac{dx}{dt} + \dfrac{dy}{dt} = x+y$ is also a differential equation but it involves two dependent variables x and y, and one independent variable t. $\dfrac{\partial^2 z}{\partial x^2} + \dfrac{\partial^2 z}{\partial y^2} = x+y$ is a differential equation having two independent variables and one dependent variable z.

Solution of a Differential Equation

A function free of derivatives is said to be a solution of the differential equation if it satisfies the differential equation, e.g., $y = \sin x$ is a solution of

differential equation $\dfrac{d^2y}{dx^2} + y = 0$

Types of Differential Equation :-

Ordinary Differential Equation :-

A differential Equation in which only derivatives w.r.t. a single independent variable present is called an ordinary differential Equation.

Partial Differential Equation : -

A differential equation in which partial derivatives w.r.t. two or more independent variables present is called a partial differential Equation.

e.g. $\left(\dfrac{dy}{dx}\right)^2 + x^2\left(\dfrac{dy}{dx}\right) = xy$ is an ordinary differential equation while $\dfrac{\partial^2 z}{\partial x^2} + \dfrac{\partial^2 z}{\partial x \partial y} = 0$ is partial differential equation.

Order and Degree of Ordinary Differential Equation

order of the Differential Equation :-

The order of the highest order derivative appearing in the differential equation is called the order of the differential Equation.

Degree of the Differential Equation

If the differential equation is made free of all fractions with regard to powers of all derivatives present, then the exponent of the highest order derivative is called the degree of the differential equation.

e.g., $\left(\dfrac{d^2y}{dx^2}\right)^{3/2} + \dfrac{dy}{dx} = y + x$ is of order 2 and 3 because it can be made into the form

$$\left(\dfrac{d^2y}{dx^2}\right)^3 = \left(y + x - \dfrac{dy}{dx}\right)^2$$

in which the exponent of $\dfrac{d^2y}{dx^2}$ is 3.

The degree of a differential equation may not always be defined.

e.g. $\dfrac{dy}{dx} = exp\left(\dfrac{dy}{dx}\right)$ has no degree which is defined.

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