08.01 Definition of Ordinary Differential Equations

What is an Ordinary Differential Equation?

An equation that consists of derivatives is called a differential equation. Differential equations have applications in all areas of science and engineering. Mathematical formulation of most of the physical and engineering problems lead to differential equations. So, it is important for engineers and scientists to know how to set up differential equations and solve them.

Differential equations are of two types

1) ordinary differential equation (ODE)
2) partial differential equations (PDE).

An ordinary differential equation is that in which all the derivatives are with respect to a single independent variable. Examples of ordinary differential equation include

1) $\frac{d^2y}{dx^2} + 2\frac{dy}{dx} + y = 0\,, \frac{dy}{dx}(0) = 2, y(0) = 4\,,$

2) $\frac{d^3y}{dx^3} + 3\frac{d^2y}{dx^2} + 5\frac{dy}{dx} + y = \sin x,\ \frac{d^2y}{dx^2}(0) = 12,\ \frac{dy}{dx}(0) = 2\,,\ y(0) = 4$

Ordinary differential equations are classified in terms of *order* and *degree*. *Order* of an ordinary differential equation is the same as the highest order derivative and the *degree* of an ordinary differential equation is the power of highest order derivative.

Thus the differential equation,

$$x^3\frac{d^3y}{dx^3} + x^2\frac{d^2y}{dx^2} + x\frac{dy}{dx} + xy = e^x$$

is of order *3* and degree *1*, where as the differential equation

$$(\frac{dy}{dx}+1)^2+x^2\frac{dy}{dx}=\sin x$$

is of order *1* and degree *2*.

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