4 /

Lec-13

Module-II

Ordinary differential equations (ODE)

without the knowledge of ODE the study of science or engineering is almost impossible.

$f : \mathbb{R} \to \mathbb{R}$

$f(x) = y(x)$

$\frac{dy}{dx}$ → derivative w.r.t. 'x' the independent variable

In real life applications we denote it as $\frac{dx}{dt}$ where $x(t)$ is 'state' of a physical system at time 't' and $\frac{dx}{dt}$ represents evolution of that state.

Exp. (1) Newton's 2nd law of motion

$$m\frac{d^2x}{dt^2} = F(t) \qquad \text{---(*)}$$

where $x(t)$ is the position of an object at time t with constant mass 'm' subject to the force $F(t)$, then $x(t)$ must satisfy eq^n (*)

(2) Assuming the biomass $m(t)$ at time 't' of a bacterial culture growing uniformly with infinite resources can be modelled as eq^n (**)

$$\frac{dm}{dt} = k\,m(t) \qquad \text{---(**)}$$

If $k>0$, the growth is exponentially
$k<0$, the decay is exponential