

Book: 2

Elementary Differential equations and
Boundary value problems

Chapter one: Introduction.

sec 1.3 *uqleq bas*

1.3 Classifications of differential
equations.

Def:

① Differential equation: (DE)
it is an equation containing
derivatives.

② Initial value problem (I.V.P)
It is an DE with initial condition.
to find a constant "C"

③ The DE's are:

(a) ODE: ordinary differential equation
(if we use function in one variable)

(b) PDE: partial differential equation.

ex on Differential equations.

$$\textcircled{1} \frac{dy}{dx} + ky = 0 \quad \text{or} \quad \dot{y} + ky = 0$$

independent variable: x ODE
dependent variable: y

$$\textcircled{2} (x^2 + y^2) dx = 2x dy \Rightarrow x^2 + y^2 = 2x \frac{dy}{dx}$$

ODE

$$\textcircled{3} u = h^2 \left(\frac{\partial^2 u}{\partial x^2} + \frac{\partial^2 u}{\partial y^2} \right)$$

$u(x, y)$ $\leftarrow \leftarrow x, y$ indep. u dep. PDE

$$\frac{dy}{dx} = \dot{y}, \quad \frac{d^2 y}{dx^2} = \ddot{y}, \quad \frac{d^3 y}{dx^3} = \dddot{y}$$

$$\frac{d^4 y}{dx^4} = \overset{\equiv}{y^{(4)}} = y^{(4)} \rightarrow \text{بدرجت رابعة}$$

y^4 : y to power "4"

$y^{(4)}$: fourth derivative.

order of a DE

It is the order of the highest derivative appears in the differential equation.

$$\text{ex } \ddot{y} + 2e^t \dot{y} + 4y = t^4$$

order = 3.

$$\text{ex } \frac{d^2 y}{dx^2} + 2 \left(\frac{dy}{dx} \right)^5 + y = 0$$

order = 2

$$\text{ex } \frac{\partial \Omega}{\partial u} + \frac{\partial^2 \Omega}{\partial u \partial v} = 0$$

$$\frac{\partial^2 \Omega}{\partial u^2}$$

order = 2

The DE is called linear if:

y and all its derivatives has max power "1", and no terms contain multiple of other.