

AGWANIRU ROSEMARY ONYINYECHI

17/ENG01/003

CHEMICAL ENGINEERING

ENG 282

### ASSIGNMENT 1

a) A differential equation is a relationship between an independent variable  $x$ , a dependent variable  $y$ , and one or more derivatives of  $y$  with respect to  $x$ .

Examples (i)  $x^2 \frac{dy}{dx} = y \sin x = 0$

ii)  $x \frac{d^2y}{dx^2} + y \frac{dy}{dx} + e^{3x} = 0$

b)  $y = Ae^{-4x} + Be^{-6x}$

i) It is a 2nd-order equation

ii) It is a 2nd-order equation because it is a function with 2 arbitrary constants i.e A and B.

iii)

$$y = Ae^{-4x} + Be^{-6x} \quad \text{--- (i)}$$

make A subject of formula

$$A = \frac{y - Be^{-6x}}{e^{-4x}} \quad \text{--- (ii)}$$

$$\frac{dy}{dx} = -4Ae^{-4x} - 6Be^{-6x}$$

$$\frac{d^2y}{dx^2} = 16Ae^{-4x} + 36Be^{-6x}$$

Substitute equation (ii) in equation (iii)

$$\frac{dy}{dx} = -4 \left[ \frac{y - Be^{-6x}}{e^{-4x}} \right] \cdot e^{-4x} - 6Be^{-6x}$$

$$\frac{dy}{dx} = -4y + 4Be^{-6x} - 6Be^{-6x}$$

$$\frac{dy}{dx} = -4y - 2Be^{-6x} \text{ ---- (v)}$$

make B subject of formula for eqn (v)

$$\frac{dy}{dx} + 4y = -2Be^{-6x}$$

$$\frac{-1}{2e^{-6x}} \left[ \frac{dy}{dx} + 4y \right] = B \text{ ---- (vi)}$$

substitute eqn (vi) in eqn (ii)

$$A = y - \frac{\left[ -\frac{1}{2e^{-6x}} \left[ \frac{dy}{dx} + 4y \right] \right] \cdot e^{-6x}}{e^{-4x}}$$

$$A = y + \frac{\frac{dy}{dx} + 2y}{2} \text{ ---- (vii)}$$

Substitute both eqn (vii) and eqn (vi) to eqn (ii)

$$\frac{d^2y}{dx^2} = \frac{16 \left[ y + \frac{\frac{dy}{dx} + 2y}{2} \right] \cdot e^{-4x}}{e^{-4x}} + 36 \left[ \frac{-1}{2e^{-6x}} \left[ \frac{dy}{dx} + 4y \right] \right] \cdot e^{-6x}$$

$$\frac{d^2y}{dx^2} = 16y + 8 \frac{dy}{dx} + 32y - 18 \frac{dy}{dx} - 72y$$

$$\frac{d^2y}{dx^2} = -16 \frac{dy}{dx} - 24y$$

$$\frac{d^2y}{dx^2} + 16 \frac{dy}{dx} + 24y = 0$$

— differential equation //