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CHEMICAL ENGINEERING

ENG 282 Assignment

a) Define differential equations and give two examples

Differential equation is the relation between an independent variable x or dependent variable y and one or more derivatives of y with respect to x

Examples:

$$- x \frac{dy}{dx} - 3y = x^7$$

$$- \cos^2 x \frac{dy}{dx} + y = 1$$

$$\text{bi } y = Ae^{-4x} + Be^{-6x} \quad \dots (1)$$

$$\frac{dy}{dx} = -4Ae^{-4x} - 6Be^{-6x} \quad \dots (2)$$

$$\frac{d^2y}{dx^2} = 16Ae^{-4x} + 36Be^{-6x} \quad \dots (3)$$

From eqn (1)

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

Subst. in eqn (2)

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

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

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

From eqn (3)

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

Subst in eqn (2)

$$\frac{dy}{dx} = -4Ae^{-4x} - 6(y - Ae^{-4x})$$

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

$$\frac{dy}{dx} = -6y + 2Ae^{-4x} \quad \dots (5)$$

From eqn (4)

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

From eqn (5)

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

Subst. eqn (4) & (5) in eqn (3)

$$\frac{d^2y}{dx^2} = 8\left(\frac{dy}{dx} + 6y\right) + 18\left(-4y - \frac{dy}{dx}\right)$$

$$\frac{d^2y}{dx^2} = 8\frac{dy}{dx} + 48y - 72y - 18\frac{dy}{dx}$$

$$\frac{d^2y}{dx^2} = -10\frac{dy}{dx} - 24y$$

$$\Rightarrow \frac{d^2y}{dx^2} + 10\frac{dy}{dx} + 24y = 0$$

i A second order differential equation can be formed

ii This is cause of the presence of the two arbitrary constants A & B