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C Chemical Engineering.
C 17/Engo1/080

Eng 282 Assignment.

Assignment 1

1a. Define differential equation and give 2 examples.

Differential equation is the relationship between an independent variable x, or dependent variable y and one or more derivative of y with respect to x

Examples: 1) $x\frac{dy}{dx} - 3y = x^7$

2) $(x^2+xy)\frac{dy^2}{dx^2} = xy - y^2\frac{dy}{dx}$

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

ii) Second order of the differential equation can be formed

iii) This is due to the presence of 2 arbitrary constants A and B

iv) $y = Ae^{-4x} + Be^{-6x}$ —— ①

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

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

From eq ① $Ae^{-4x} = y - Be^{-6x}$ —— ④

Substitute ④ in eq 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 eq ① $Be^{-6x} = y - Ae^{-4x}$ —— ⑤

Substitute ⑤ in ② $\frac{dy}{dx} = -4Ae^{-4x} - 6(y - Ae^{-4x})$

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

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

from eqn (A) : $2Be^{-6x} = -4y - \frac{dy}{dx}$ — (C)

from eqn (B) : $2Ae^{-4x} = dy/dx + 6y$ — (D)

Substitute (C) and (D) in eqn (3)

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

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

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

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