IDOWU JOHN AYOKUNLE
PETROLEUM ENGINEERING
17/ENG07/013.

8

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 of differential equation

$$x^2\frac{dy}{dx} = y^{\sin x} + 0$$

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

1b(i) $y = Ae^{-4x} + Be^{-6x}$

This is a second order differentiation

ii) It has two constants A and B

iii) Let Ae^{-4x} be R
and let Be^{-6x} be S

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

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

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

$$\therefore y = R + S \quad \text{---(i)}$$

$$\frac{d^2y}{dx} = -4R - 6S \quad \text{---(ii)}$$

$$\frac{d^2y}{dx^2} = 16R + 36S \quad \text{---(iii)}$$

From equation (ii)

$$R = \left(\frac{dy}{dx} + 6S\right)\frac{1}{4} \quad \text{---(iv)}$$

Put equation (iv) in equation (v)

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

$$\frac{d^2y}{dx^2} = -4\frac{dy}{dx} - 24s + 36s$$

$$\frac{d^2y}{dx^2} + 4\frac{dy}{dx} = 12s$$

$$s = \left(\frac{d^2y}{dx^2} + 4\frac{dy}{dx}\right)\frac{1}{12} \quad ---(v)$$

Put equation (v) in equation (iv)

$$R\left[\frac{dy}{dx} + 6\left(\frac{d^2y}{dx^2} + 4\frac{dy}{dx}\right)\frac{1}{12}\right] x - \frac{1}{4}$$

$$R = \left(\frac{dy}{dx} + \frac{1}{2}\frac{d^2y}{dx^2} + 2\frac{dy}{dx}\right) x - \frac{1}{4}$$

$$R = \left[3\frac{dy}{dx} + \frac{1}{2}\frac{d^2y}{dx^2}\right] x - \frac{1}{4} \quad --- (v_1)$$

Put equation V and V_1 in equation (i)

$$y = \left(\frac{d^2y}{dx^2} + 4\frac{dy}{dx}\right)\frac{1}{12} + \left[\left(3\frac{dy}{dx} + \frac{1}{2}\frac{d^2y}{dx^2}\right) x$$

$$y = \frac{1}{24}\frac{d^2y}{dx^2} + \frac{5}{12}\frac{dy}{dx}$$

$$y + \frac{1}{24}\frac{d^2y}{dx^2} + \frac{5}{12}\frac{dy}{dx} = 0$$

multiply through by 24

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