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PETROLEUM ENGINEERING

ENG 281, ASSIGNMENT I

$$\frac{d}{dx} \left(\frac{1}{x} + \frac{1}{x^2} \right) = -\frac{1}{x^2} - \frac{2}{x^3}$$

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

Examples of differential equation:

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

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

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

This is a second order differentiation.

(ii) It has two constants, A and B

(i) Let Ae^{-4x} be R

and let Be^{-6x} be S

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

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

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

$$\therefore y = R + S \dots (1)$$

$$\frac{dy}{dx} = -4R - 6S \dots (2)$$

$$\frac{d^2 y}{dx^2} = 16R + 36S \dots (3)$$

From eqn (2)

$$R = \left(\frac{dy}{dx} + 6S \right) \frac{1}{4} \dots (4)$$

Put eqn (4) in equation (3)

$$\frac{d^2 y}{dx^2} = \frac{1}{4} \left(\left(\frac{dy}{dx} + 6s \right) \times \frac{1}{4} \right) + 36s$$

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

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

$$S = \left(\frac{d^2 y}{dx^2} + 4 \frac{dy}{dx} \right) \frac{1}{12} \quad \text{--- (5)}$$

Put Equation (5) in Equation (4)

$$R = \left(\frac{dy}{dx} + 6 \left(\frac{d^2 y}{dx^2} + \frac{4dy}{dx} \right) \frac{1}{12} \right) \times \frac{1}{4}$$

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

$$R = \left(\frac{3dy}{dx} + \frac{1}{2} \frac{d^2 y}{dx^2} \right) \times \frac{1}{4} \quad \text{--- (6)}$$

Put Eqn (5) and (6) in Equation (1)

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

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

$$y = \frac{1}{12} \frac{d^2 y}{dx^2} + \frac{1}{3} \frac{dy}{dx} - \frac{3}{4} \frac{dy}{dx} - \frac{1}{8} \frac{d^2 y}{dx^2}$$

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

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

Multiply through by 24

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