ASSIGNMENT 1

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

E.g (1) $\frac{dy}{dx} = 2 + y/x$

(2) $\frac{dy}{dx} = y + y/x$

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

(1) A second order differential equation

(2) A second order differential equation can be formed because it contains 2 constants in degenerate equation.

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

Solution.

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

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

Solving eqn(1) and 2 simultaneously.

$$\therefore 6\frac{dy}{dx} = -24Ae^{-4x} - 36Be^{-6x} \quad --(iii)$$

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

$$6\frac{dy}{dx} + \frac{d^2y}{dx^2} = -8Ae^{-4x} \quad ---(v)$$

$$\therefore A = \frac{6\frac{dy}{dx} + \frac{d^2y}{dx^2}}{-8e^{-4x}}$$

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Substituting eqn (v) into eqn (1)

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

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

Multiply through by 2.

$$2\frac{dy}{dx} = 6\frac{dy}{dx} + \frac{d^2y}{dx^2} - 12Be^{-6x}.$$

$$2\frac{dy}{dx} - 6\frac{dy}{dx} = -12Be^{-6x} - \frac{d^2y}{dx^2}.$$

$$-4\frac{dy}{dx} - \frac{d^2y}{dx^2} = -12Be^{-6x}.$$

$$\frac{-4\,dy/dx - d^2y/dx^2}{-12e^{-6x}} = B$$

$$\therefore B = \frac{4\,dy/dx + d^2y/dx^2}{12e^{-6x}}$$

Substitute A and B into degenerate eqn.

$$y = \frac{6\frac{dy}{dx} + \frac{d^2y}{dx^2}}{-8e^{-4x}} \times e^{-4x} + \frac{4\frac{dy}{dx} + \frac{d^2y}{dx^2}}{12e^{-6x}} \times e^{-6x}$$

$$y = \frac{-72\,dy/dx - 12\frac{d^2y}{dx^2} + 32\frac{dy}{dx} + 8\frac{d^2y}{dx^2}}{96}$$

$$y = \frac{-40\,dy/dx - 4\,d^2y/dx^2}{96} \quad 96y = -40\frac{dy}{dx} - 4\frac{d^2y}{dx^2}$$

$\div 4$ $\quad 24y = -10\,dy/dx - d^2y/dx^2$

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