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 Computer Engineering
 ENGG252: Engineering Mathematics II
 Assignment 1

1a A differential equation is a relationship between dependent and independent Variable and one or more derivatives of the dependent variable with respect to independent variable.

i $x \frac{dy}{dx} = 2x - y$
 ii $y = 2 \frac{dy}{dx} - x^2 \frac{d^2y}{dx^2}$

b) Second Order Equation

ii It is a second order equation because it has two arbitrary constants.

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

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

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

$A = \frac{y - Be^{-6x}}{e^{-4x}}$ --- (4)

Substituting eqm (4) into (2):

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

$= -4y + 4Be^{-6x} - 6Be^{-6x}$ --- (5)

$= -4y - 2Be^{-6x}$

Making B the subject of the formula

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

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

$\frac{1}{2e^{-6x}} \left[\frac{dy}{dx} + 4y \right] = B$ --- (6)

Substituting equation 6 into (4)

$A = \frac{y - Be^{-6x}}{e^{-4x}}$

$$A = y - \left[\frac{-1}{2e^{-6x}} \left[\frac{\partial y}{\partial x} + 4y \right] e^{-6x} \right]$$

$$A = y + \frac{\frac{\partial y}{\partial x} + 4y}{2e^{-6x}} \quad \text{--- (7)}$$

Substituting eqn 7 into 6

$$\begin{aligned} \frac{d^2 y}{dx^2} &= 16Ae^{-6x} + 36Be^{-6x} \\ &= 16 \left[y + \frac{\frac{\partial y}{\partial x} + 4y}{2e^{-6x}} \right] e^{-6x} + 36 \left[\frac{-1}{2e^{-6x}} \left[\frac{\partial y}{\partial x} + 4y \right] e^{-6x} \right] \end{aligned}$$

$$\frac{\partial^2 y}{\partial x^2} = 16y + 16 \frac{\partial y}{\partial x} + 32y - 36 \frac{\partial y}{\partial x} - 72y$$

$$\frac{\partial^2 y}{\partial x^2} = 16y + 18 \frac{\partial y}{\partial x} + 32y - 18 \frac{\partial y}{\partial x} - 72y$$

$$= -24y - 18 \frac{\partial y}{\partial x}$$

$$\frac{\partial^2 y}{\partial x^2} + 24y + 18 \frac{\partial y}{\partial x} = 0$$