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Computer Engineering

COURSE: ECE 282

1a) 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

Ex: i) $\frac{dy}{dx} = 2 + \frac{y}{x}$

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

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

i) A Second order differential equation

ii) This is because it contains two variables

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

solution

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

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

Solving equation (i) and (ii) simultaneously
multiply equ (i) by 6

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

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

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

$A = 6 \frac{dy}{dx} + \frac{d^2y}{dx^2} \quad \text{--- (v)}$

Substituting eqn (1) into eqn (c)

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

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

Multiply through by 2

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

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

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

$$= 4 \frac{dy}{dx} - \frac{d^2y}{dx^2} = B$$

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

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

$$y = \frac{7 \frac{dy}{dx} + 3 \frac{d^2y}{dx^2} - 8 \frac{dy}{dx} - 2 \frac{d^2y}{dx^2}}{-24}$$

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

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

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

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