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Civil Engineering

17/ENG081015

ENG 282 Assignment 1

1(a) 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  $x$ .

example of differential equation;

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

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

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

i This is a Second order differential Equation  
ii it is because it has two constants A and B

iii let  $Ae^{-4x}$  be R

and let  $Be^{-6x}$  be S

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

$$\frac{dy}{dx}$$

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

$$\therefore y = R + S \text{ --- (1)}$$

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

$$\frac{d^2y}{dx^2}$$

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

from equation (3)

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



Put (4) into (3)

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

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

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

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

Put (5) into (4)

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

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

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

Put equation (6) and (6) into (1)

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

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

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

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

Multiply through by 24

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