SOLOMON ICHECHUKWU FRANCIS

13/ENG01/010

CHEMICAL ENGINNEERING

PROCESS DYNAMICS AND CONTROL

$$\frac{d^2y}{dt^2} = y^{II}, \frac{dy}{dt} = y^{I},$$

Where y(0) = 5 , $\dot{y(0)} = 7$

$$y^{II} - 3(y^{I}) + 2y = 2e^{3t}$$

$$L(y^{II}) - L3(y^{I}) + L2y = L2e^{3t}$$

$$S^2y - sy(0) - \dot{y}^{I}(0) - 3[sy(s) - y(0)] + 2y(s) = 2[\frac{1}{s-3}]$$

$$S^2y(s) - 5s - 7 - 3sy(s) - 3 * -5 + 2y(s) = 2[\frac{1}{s-3}]$$

$$S^2y(s) - 3sy(s) - 5s + 2y(s) - 7 + 15 = 2[\frac{1}{s-3}]$$

$$S^2y(s) - 3sy(s) - 5s + 2y(s) - 7 + 15 = 2[\frac{1}{s-3}]$$

$$S^2y(s) - 3sy(s) + 2y(s) - 5s + 8 = 2[\frac{1}{s-3}]$$

$$y(s)[S^2 - 3s + 2] - 5s + 8 = \frac{2}{s-3}$$

$$y(s)[S^2 - 3s + 2] = \frac{2}{s-3} - 8 + 5s$$

$$y(s)[S^2 - 3s + 2] = \frac{2 - 8(s-3) + 5s(s-3)}{s-3}$$

$$y(s)[S^2 - 3s + 2] = \frac{2 - 8s + 24 + 5s^2 - 15s}{s-3}$$

$$y(s)[S^2 - 3s + 2] = \frac{5s^2 - 23s + 26}{s-3}$$

$$y(s) = \frac{5s^2 - 23s + 26}{s-3} \cdot \frac{1}{s^2 - 3s + 2}$$

$$y(s) = \frac{(s-2)\ (s - \frac{13}{5})}{(s-3)(s-1)(s-2)}$$

$$y(s) = \frac{(s-2)\,(5s-13)}{(s-3)(s-1)(s-2)}$$

Using partial fractions;

$$\frac{5s-13}{(s-3)(s-1)} = \frac{A}{s-3} + \frac{B}{s-1}$$

$$\frac{5s-13}{(s-3)(s-1)} = \frac{A(s-1)+B(s-3)}{(s-3)(s-1)}$$

$$5s-13 = As - A + Bs - 3B$$

$$5s-13 = (A+B)s - A - 3B$$

$$A+B = 5 \ \ldots\ldots(1)$$

$$-A-3B = -13$$

$$-(A+3B) = -13 \ \ldots\ldots\ldots(2)$$

Subtracting equation (2) from (1)

$$-2B = -8$$

$$B = 4$$

$$A+B = 5$$

$$A+4 = 5$$

$$A = 5-4 = 1$$

$$y(s) = \frac{5s-13}{(s-3)(s-1)} = \frac{1}{s-3} + \frac{4}{s-1}$$

$$y(t) = L^{-1}\big(y(s)\big) = L^{-1}\left[\frac{1}{s-3} + \frac{4}{s-1}\right]$$

$$y(t) = e^{3t} + 4e^{t}$$