

ELINDU DIVINE

15/ENGEE/026

METALLICAL ENGINEERING

ENG 381

$$1. \frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 5y = 6\sin t$$

convert equation to homogeneous equation

$$\frac{d^2y}{dt^2} + 4\frac{dy}{dt} + 5y = 0$$

$$m^2 + 4m + 5 = 0$$

$$a=1, b=4, c=5$$

$$m = \frac{-4 \pm \sqrt{4^2 - 4 \cdot 1 \cdot 5}}{2 \cdot 1}$$

$$2 \cdot 1$$

$$m = \frac{-4 \pm \sqrt{4}}{2}$$

$$m = -4 \pm j \frac{1}{2}$$

$$m = -2 \pm j$$

complementary function

$$y = e^{-2t} (A \cos t + B \sin t)$$

$$y = (C \cos t + D \sin t)$$

$$\frac{dy}{dt} = -(C \sin t + D \cos t)$$

$$\frac{d^2y}{dt^2} = -(C \cos t + D \sin t)$$

Substitute y , $\frac{dy}{dt}$, $\frac{d^2y}{dt^2}$ into the equation

$$-(C \cos t + D \sin t) + 4(-C \sin t + D \cos t) + 5(C \cos t + D \sin t) = 6 \sin t$$

$$-C \cos t - D \sin t + 4(-C \sin t + D \cos t) + 5(C \cos t + D \sin t) = 6 \sin t$$

$$-C \cos t + 5C \cos t = 0$$

$$4D + 4C = 0 \dots (1)$$

$$-D + 4(-5D) = 6$$

$$4D + 4C = 6 \dots (2)$$

equating both equations

$$4D + 4C = 0 \dots (1)$$

$$4D + 4C = 6 \dots (2)$$

$$5C = 6$$

$$C = \frac{3}{4}$$

Substitute e into equation (2)

$$4D + 9(3/4) = 6$$

$$4D + 3 = 6$$

$$4D = 6 - 3$$

$$D = 3/4$$

Particular integral

$$y_p = 3/4 \cos \theta + 3/4 \sin \theta$$

$$y = e^{-2\theta} (A \cos \theta + B \sin \theta) + 3/4 \cos \theta + 3/4 \sin \theta$$

Q3 = P.F. + P.I.

$$y = e^{-2\theta} (A \cos \theta + B \sin \theta) + 3/4 (\cos \theta + \sin \theta)$$

at steady state

$$\theta = \pi \quad dy/d\theta = 0$$

$$y = e^{-2\theta} (A \cos \theta + B \sin \theta) + 3/4 (\cos \theta + \sin \theta)$$

$$dy/d\theta = -2e^{-2\theta} (-A \sin \theta + B \cos \theta) + 3/4 (-\sin \theta + \cos \theta)$$

$$0 = -2e^{-2\theta} (B \cos \theta - A \sin \theta) + 3/4 (\cos \theta - \sin \theta)$$

$$2 \cos \theta = 3/4 \cos \theta$$

$$B = 3/4 \cos \theta - 3/4 \sin \theta$$

$$3/4 \sin \theta = 3/4 \cos \theta$$

$$\tan \theta = 1$$

$$\theta = \pi/4$$

$$y = 2e^{-\pi/2} = 1$$

$$2 \int \frac{dx}{x^2} = c/x (1-x)^2$$

convert equation to homogeneous equation

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

$$[1] m^2 = 0$$

$$m^2 = 0$$

$$m = 0 \text{ or } 0$$

$$m_1 = m_2 = 0$$

$$y = e^{0x} (A + Bx)$$

complementary function

$$y = A + Bx$$



MORE

$$\frac{dy}{dx} = 70x = 15x^2 + 47x^3$$

$$\frac{dy}{dx} = 2x + 50x + 177x^3$$

$$11(7x + 50x + 177x^3) = \frac{u}{2}(1-x)^2$$

$$247x + 207x + 177x^3 = \frac{u}{2}(1^2 - 2x + x^2)$$

multiply by equation 2

$$494x + 12(247x + 177x^3) = u(1^2 - 2x + x^2)$$

$$247x = u$$

$$x = \frac{u}{247}$$

$$12(247) = -2u$$

$$S = -247/247$$

$$y = \left(\frac{u^2}{494}\right)x^2 - \left(\frac{u}{247}\right)x + \left(\frac{u}{247}\right)x^3$$

$$y = \frac{u^2 x^2}{494} - \frac{u x}{247} + \frac{u x^3}{247}$$

$$y = 6x^2 x^2 - 4x^2 + \frac{u x^3}{247}$$

$$y = \frac{u}{247} (6x^2 x^2 - 4x^2 + x^3) \text{ (particular integrals)}$$

$$G.S = C.F + P.I$$

$$y = A + Bx + \frac{u}{247} (6x^2 x^2 - 4x^2 + x^3)$$

at $x=0, y=0, \frac{dy}{dx}=0$

$$0 = A + B(0) + \frac{u}{247} (12(0) - 4(0) + 0)$$

$$0 = B + \frac{u}{247} (12(0) - 12(0) + 0)$$

$$B = 0$$

also $A = B = 0$

$$y = 0 + 0 + \frac{u}{247} (6x^2 x^2 - 4x^2 + x^3)$$

$$y = \frac{u}{247} (6x^2 x^2 - 4x^2 + x^3)$$

also $x=1$

$$y = \frac{u}{247} (6(1)^2 - 4(1) + 1)$$

$$y = \frac{u}{247} (1)$$

$$y = \frac{1}{247}$$

at $x=0, \frac{dy}{dx}=0$

$$\frac{dy}{dx} = A + B + \frac{u}{247} (12(0) - 4(0) + 0)$$

$$\frac{dy}{dx} = A + B + \frac{u}{247} (12(0) - 12(0) + 0)$$



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