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Elect/Elat

IS/ENGR4/036

$$1) \frac{d^2 y}{dx^2} - \frac{dy}{dx} - 2y = 8$$

Cf

$$m^2 - m - 2m - 2 = 0$$

$$m(m+1) - 2(m+1)$$

$$m = -1 \text{ or } 2$$

$$y = Ae^{-x} + Be^{2x}$$

PI

Assumed PI:  $yx$

$$\frac{dy}{dx} = 0$$

$$\frac{d^2 y}{dx^2} = 0$$

Substituting in the original eqn

$$0 - 0 - 2c = 8$$

$$-2c = 8$$

$$c = -4$$

$$y = -4$$

The general soln is

Cf PI

$$y = Ae^{-x} + Be^{2x} - 4$$

$$\frac{d^2 y}{dx^2} - 4y = 10e^{3x}$$

Cf

Comparing with

$$\frac{d^2 y}{dx^2} - n^2 y = 0$$

$$n^2 = 4$$

$$n = 2$$

$$y = A \cosh 2x + B \sinh 2x$$

assumed PI

$$y = ce^{3x}$$

$$\frac{dy}{dx} = 3ce^{3x}$$

$$\frac{d^2 y}{dx^2} = 9ce^{3x}$$

substituting in the original eqn.

$$\frac{d^2 y}{dx^2} - 4y = 10e^{3x}$$

$$9ce^{3x} - 4ce^{3x} = 10e^{3x}$$

$$5ce^{3x} = 10e^{3x}$$

$$c = \frac{10e^{3x}}{5e^{3x}}$$

$$c = 2$$

$$y = 2e^{3x}$$

general soln

$$y = A \cosh 2x + B \sinh 2x + 2e^{3x}$$

$$3 \quad \frac{d^2 y}{dx^2} + 2 \frac{dy}{dx} + y = e^{-2x}$$

$$\text{CF: } m^2 + 2m + 1 = 0$$

$$m(m+1) + 1(m+1)$$

$$m = -1 \pm i$$

$$y = e^{-x} [A + Bx]$$

PI

$$\text{Assumed PI: } y = ce^{-2x}$$

$$\frac{dy}{dx} = -2ce^{-2x}$$

$$\frac{d^2 y}{dx^2} = 4ce^{-2x}$$

$$\text{Substituting in the original eqn}$$

$$4ce^{-2x} - 4ce^{-2x} + ce^{-2x} = e^{-2x}$$

$$ce^{-2x} [4 - 4 + 1] = e^{-2x}$$

$$ce^{-2x} = e^{-2x}$$

$$c = \frac{e^{-2x}}{e^{-2x}}$$

The PI is

$$y = e^{-2x}$$

The general soln

$$y = e^{-x} [A + Bx] + e^{-2x}$$

The PI is  
 $y = e^{-2x}$

The general solution.

$$y = e^{-2x} [A + Bx] + e^{-2x}$$

1)  $\frac{d^2y}{dx^2} + 25y = 5x^2 + x$

CF: comparing with

$$\frac{d^2y}{dx^2} + n^2y = 0$$

$$n^2 = 25$$

$$n = 5$$

$$y = A \cos 5x + B \sin 5x$$

PI: assumed PI:  $y = cx^2 + Dx + E$

$$\frac{dy}{dx} = 2cx + D$$

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

Substitute in the original equation.

$$2c + 25[ cx^2 + Dx + E ] = 5x^2 + x$$

$$2c + 25cx^2 + 25Dx + 25E = 5x^2 + x$$

$$25cx^2 + 25Dx + 25E + 2c = 5x^2 + x$$

2

$$25c = 5 \quad [x^2]$$

$$c = 1/5$$

$$25D = 1 \quad [x]$$

$$D = 1/25$$

2

$$25E + 2c = 0$$

$$25E = -2/5$$

$$E = -2/5 \times 1/25$$

$$E = -2/50 = -1/25$$

PI

$$y = \frac{x^2}{5} + \frac{x}{25} - \frac{1}{25}$$

The general solution.

$$y = A \cos 5x + B \sin 5x + \frac{x^2}{5} + \frac{x}{25} - \frac{1}{25}$$

5)  $\frac{d^2y}{dx^2} - 2\frac{dy}{dx} + y = 4 \sin x$

CF.

$$m^2 - 2m + 1 = 0$$

$$m^2 - m - m + 1 = 0$$

$$m(m-1) - 1(m-1) = 0$$

$m = 1$  twice.

$$y = e^x [A + Bx]$$

PI: assumed PI

$$y = C \cos x + D \sin x$$

$$\frac{dy}{dx} = -C \sin x + D \cos x$$

$$\frac{d^2y}{dx^2} = -C \cos x - D \sin x$$

Substituting in the original equation

$$-C \cos x - D \sin x - 2[-C \sin x + D \cos x] + C \cos x + D \sin x = 4 \sin x$$

$$-C \cos x - D \sin x + 2C \sin x - 2D \cos x + C \cos x + D \sin x = 4 \sin x$$

$$\cos x [-C - 2D + C] + \sin x [-D + 2C + D] = 4 \sin x$$

$$2C = 4 \quad [3 \sin x]$$

$$C = 2$$

$$-2D = 0 \quad [2 \cos x]$$

$$D = 0$$

PI

$$y = 2 \cos x$$

The general solution is.

$$y = e^x [A + Bx] + 2 \cos x$$

6)  $\frac{d^2y}{dx^2} + 4\frac{dy}{dx} + 5y = 2e^{-2x}$

CF

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

$$\frac{-4 \pm \sqrt{16-20}}{2}$$

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

$$\frac{-4 \pm j\sqrt{4}}{2}$$

$$= -2 \pm j$$

$$y = e^{-2x} [A \cos x + B \sin x]$$

PI

$$y = ce^{-2x}$$

$$\frac{dy}{dx} = -2ce^{-2x}$$

$$\frac{d^2y}{dx^2} = 4ce^{-2x}$$

Substituting in the original equation.

$$4ce^{-2x} + (-2ce^{-2x}) + 5ce^{-2x} = 2e^{-2x}$$

$$4ce^{-2x} - 8ce^{-2x} + 5ce^{-2x} = 2e^{-2x}$$

$$ce^{-2x} [4 - 8 + 5] = 2e^{-2x}$$

$$ce^{-2x} = 2e^{-2x}$$

$$c = 2$$

PI

$$y = 2e^{-2x}$$

general solution.

$$y = e^{-2x} [A \cos x + B \sin x] + 2e^{-2x}$$

$$x=0; y=1$$

$$1 = [A] + 2$$

$$\therefore A = 1 - 2$$

$$A = -1$$

$$x=0, \frac{dy}{dx} = -2$$

dx

$$\frac{dy}{dx} = -e^{-2x} [-A \sin x + B \cos x] - 2e^{-2x} [A \cos x + B \sin x] - 4e^{-2x}$$

$$-2 = [0 + B] - 2[A] - 4$$

$$-2 = B + 2 - 4$$

$$-2 = B - 2$$

$$B = 0$$

CF

$$m^2 - 6m + 8 = 0$$

$$m^2 - 4m - 2m + 8 = 0$$

$$m(m-4) - 2(m-4)$$

$$m = 4 \text{ or } 2$$

$$y = Ae^{4x} + Be^{2x}$$

PI

$$y = Cxe^{4x}$$

$$\frac{dy}{dx} = 4Cxe^{4x} + Ce^{4x}$$

$$\frac{d^2y}{dx^2} = 16Cxe^{4x} + 4Ce^{4x} + 4Ce^{4x}$$

$$16Cxe^{4x} + 4Ce^{4x} + 4Ce^{4x} - 24Cxe^{4x} - 6Ce^{4x} + 8Cxe^{4x} = 8e^{4x}$$

$$Cxe^{4x}[16 - 24 + 8] + Ce^{4x}[4 + 4 - 6] = 8e^{4x}$$

$$C\cancel{e}e^{4x}[0] + 2Ce^{4x} = 8e^{4x}$$

$$C = \frac{8e^{4x}}{2e^{4x}}$$

$$C = 4$$

PI := 4

$$y = 4xe^{4x}$$

$$y = \underline{Ae^{4x} + Be^{2x} + 4xe^{4x}}$$