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Mechanical Engineering
16/ENG06/041
ENG 381

Assignment

$$\frac{d^2x}{dt^2} + 5\frac{dx}{dt} + 6x = \cos t$$

C.F:

$$\frac{d^2x}{dt^2} + 5\frac{dx}{dt} + 6x = 0$$

$$m^2 + 5m + 6 = 0$$

$$m^2 + 3m + 2m + 6 = 0$$

$$m(m+3) + 2(m+3) = 0$$

$$(m+3)(m+2) = 0$$

$$m = -3 \quad \text{or} \quad m = -2$$

C.F: $x = Ae^{-3t} + Be^{-2t}$

P.I:

$$f(x) = \cos t$$

$$x = A\cos t + B\sin t$$

$$\frac{dx}{dt} = -A\sin t + B\cos t$$

$$\frac{d^2x}{dt^2} = -A\cos t - B\sin t$$

replace in initial equation

$$(-A\cos t - B\sin t) + 5(-A\sin t + B\cos t) + 6(A\cos t + B\sin t) = \cos t$$

$$-A\cos t - B\sin t - 5A\sin t + 5B\cos t + 6A\cos t + 6B\sin t = \cos t$$

$$-5A\sin t + 5A\cos t + 5B\sin t + 5B\cos t = \cos t$$

$$5A\cos t + 5B\cos t - 5A\sin t + 5B\sin t = \cos t$$

$$\cos t(5A + 5B) + \sin t(-5A + 5B) = \cos t$$

Comparing and collecting like terms

$$5A + 5B = 1$$

$$+ \quad -5A + 5B = 0$$

$$10B = 1$$

$B = \frac{1}{10}$

sub $B = \frac{1}{10}$ into $5A + 5B = 1$

$5A + 5(\frac{1}{10}) = 1$

$5A + \frac{1}{2} = 1$

$5A = 1 - \frac{1}{2}$

$5A = \frac{1}{2}$

$A = \frac{1}{10}$

P.I : $\frac{1}{10}\cos t + \frac{1}{10}\sin t$

$= \frac{1}{10}(\cos t + \sin t)$

$y = C.F + P.I$

$y = Ae^{-3t} + Be^{-2t} + \frac{1}{10}(\cos t + \sin t)$

Command window

```
clear
clc
syms t
x = -0.2 * exp(-3 * t) + 0.3 * exp(-2*t) + 0.1* cos(t) + 0.1*sin(t)
tn = [0:0.01:15]
xn = subs(x, tn)
figure(1)
plot(tn, xn)
xlabel('distance')
ylabel('time')
axis tight
grid on
grid minor
```

steady state equation

$$x = \frac{\sqrt{2}}{10} \sin\left(t + \frac{\pi}{\partial}\right)$$