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* **17/ENG01/021**
* **CHEMICAL ENGINEERING**
* **ENG 381 ASSIGNMENT 1**

**Solution to the Assignment**

1. *+ + 6x = cos t*

Using the Auxiliary Equation method to obtain the solution of the model.

1. Finding the Complementary Function, CF

*+ + 6x = 0*

Therefore, the CF is x = Ae-2t + Be-3t (\*)

1. For the Particular Integral

f (t)= cos t

x = C cos t + D sin t (\*\*)

*= C sin t + D cos t*

*= C cos t – D sin t*

Substitution into the Original equation

– C cos t – D sin t + 5[–C sin t + D cos t] + 6[C cos t + D sin t] = cos t

– C cos t – D sin t – 5C sin t + 5D cos t + 6C cos t + 6D sin t = cos t

5D cos t – C cos t + 6C cos t + 6D sin t – D sin t – 5C sin t = cos t

5D cos t + 5C cos t + 5D sin t – 5C sin t = cos t

cos t [5D + 5C] + sin t [5D – 5C] = cos t

Equating coefficients

5D + 5C = 1 (i)

–

5D – 5C = 0 (ii) solving by Elimination Method

5C – (–5C) = 1 – 0

5C + 5C = 1

10C = 1

C =

Substitute into equation(i)

5D + 5[ = 1

5D + = 1 (ii)

5D = 1 –

5D =

10D = 1

D =

Therefore, the Particular Integral, PI is x = + (\*\*\*)

Complete general solution = CF + PI

Therefore, General Solution is x = Ae-2t + Be-3t +  + (\*\*\*\*)

At t = 0, x = 0.1 and = 0

0.1 = Ae-2(0) + Be-3(0) +  +

0.1 = A + B+  + 0

A + B =

A + B = (iii)

From equation (\*\*\*\*)

x = Ae-2t + Be-3t +  +

= –2Ae-2t – 3Be-3t –  +

0 = –2Ae-2(0) – 3Be-3(0) –  +

0 = –2A – 3B – 0 +

2A + 3B = (iv)

From equation (iii)

A + B = 0

A = –B (v)

Substitute equation (v) into (iv)

2(–B) + 3B =

–2B + 3B =

B =

Substitute for B into (iii)

A + [ = 0

A =

The Particular Solution for the model is x = ++  +

x =

1. MATLAB file

* Commandwindow
* Clear
* Clc
* Close all
* Syms t
* t=0:0.01:15
* x = 0.1\*[exp(-2\*t) – exp(-3\*t) + cos(t) + sin(t)]
* xn = subs(x)
* plot (t,xn)
* axis tight
* grid on
* grid minor

1. To write the Steady state solution in the form of x = K sin (t + a)

The steady state solution of the body is the Particular Integral on the RHS of the General Solution.

From Equation (\*\*\*\*)

The steady state solution is x = [cos t + sin t]

Because the LHS; ] tends to infinite. This is known as the Transient solution.

x = [cos t + sin t]

substituting which is equal to 1

x =

x =

Recall that sin (45) = cos (45) = =

x =

x =

Recall that

So substituting

x = …………… (\*\*\*\*\*)

So equation (\*\*\*\*\*) is the steady state solution in the form x = K sin (t + a).

Where K =

a =