

**COLLEGE OF ENGINEERING**

**DEPARTMENT OF CHEMICAL AND PETROLEUM ENGINEERING**

**PROCESS DYNAMICS & CONTROL**

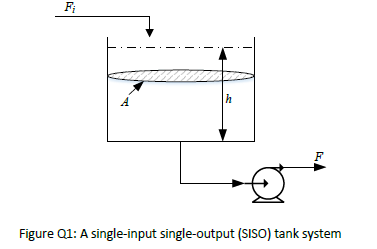
**CHE 531 ASSIGNMENT II**

**BY**

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**14/ENG01/016**

QUESTION 1



Mass Balance

-----------------------------------(1a)

-------------------------(1b)

-------------------------------(1c)

--------------------------------------(2)

---------------------------------(3a)

----------------------------------(3b)

-----------------------------------(4)

is a non-linear term. To develop the linearized approximation for the non-linear model, the Taylor series expansion of the term, , around a point will be taken:

Neglecting terms of order two and higher. We’ll have:

-----------(\*)

Substituting equation (\*) in equation (4) will give

-------------------(5)

The equation above is the dynamic state equation. At steady state, the equation will be:

-------------------(6)

Subtracting equation 6 from 5

-------------------(7)

But , then equation (7) will become

-------------------(8)

Dividing through by will give

--------------------(9)

Let and

Then equation (9) will be

----------------(10)

To find the transfer function, we’ll have to get the Laplace of the system:

----------------(11)

-------------------------------12

--------------------------------------12a

----------------------------------------13

Equation 13 is the transfer function equation.

and

To solve manually:

Applying a unit step change in the manipulated variable:

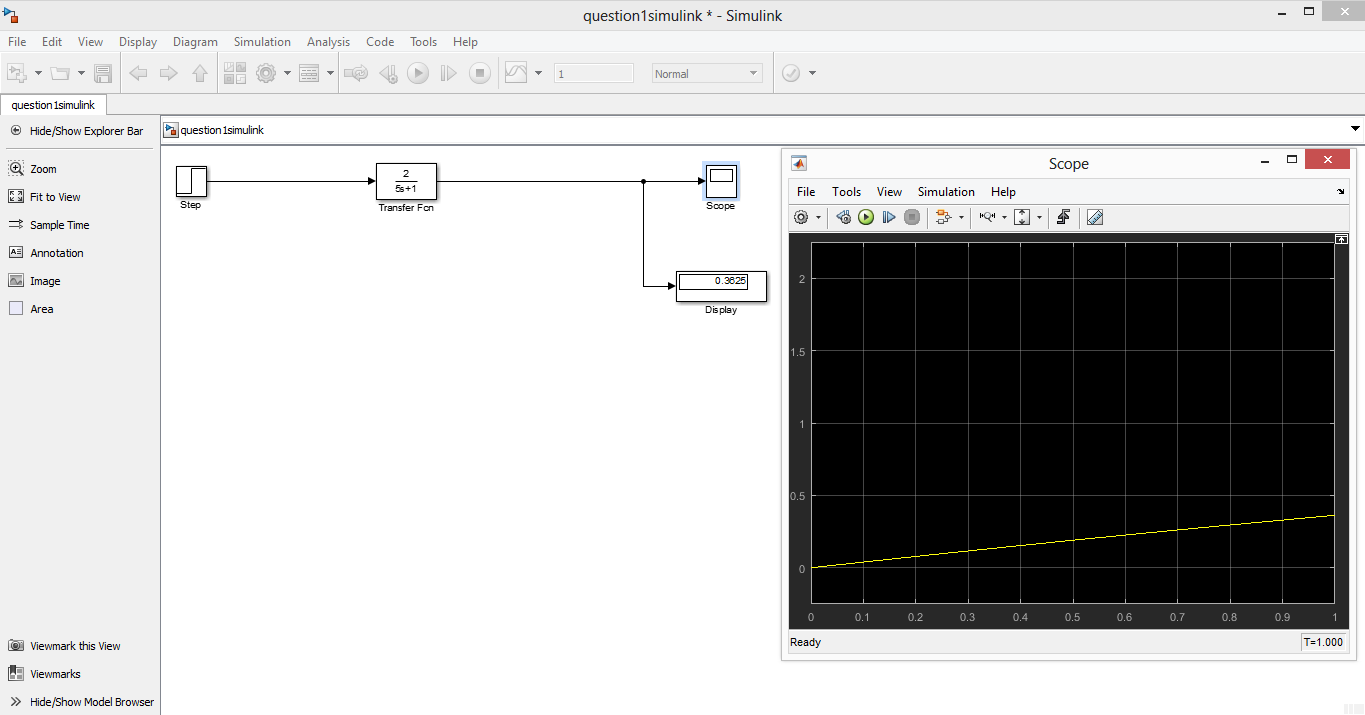
Solving by Partial fraction

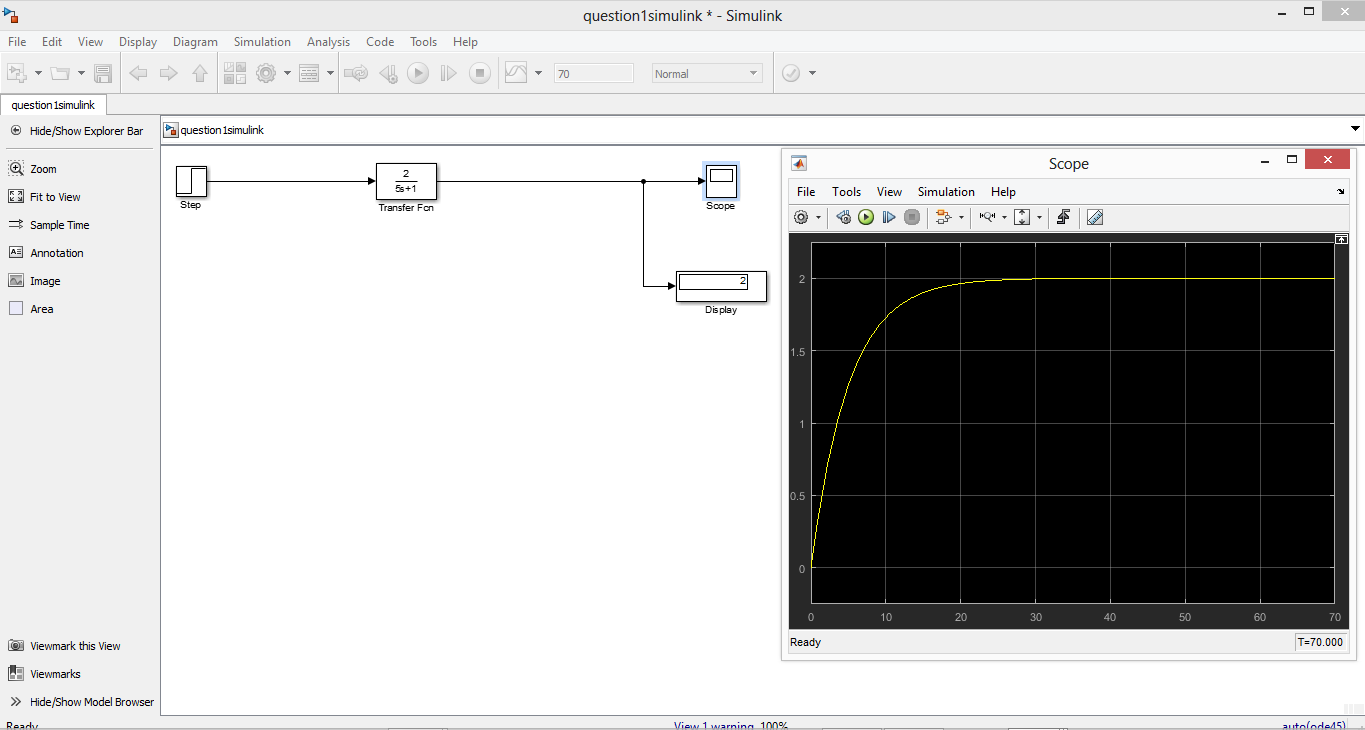
Let

Let

Taking the inverse Laplace of will give:

, the model reaches steady state at t=30mins

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**QUESTION 2**

Set point method:

Solving by Partial fraction

Let

Let

Taking the inverse Laplace of will give:

