Control Theory
CA3
Reyhaneh Esmailizadeh
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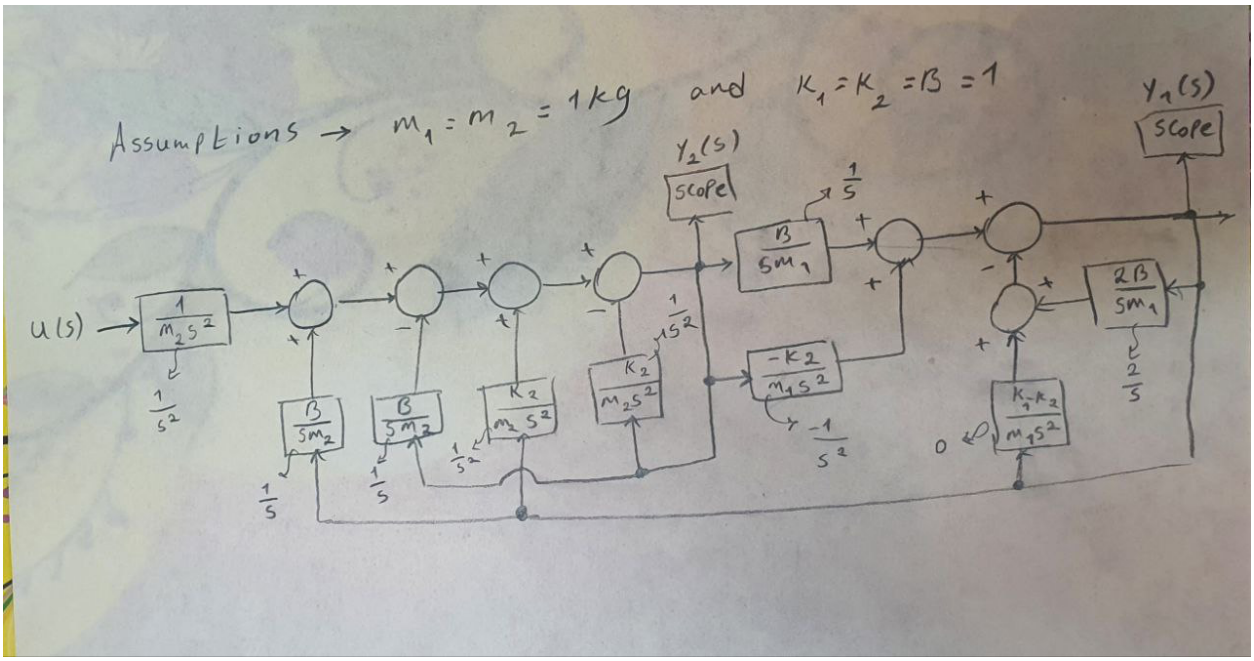
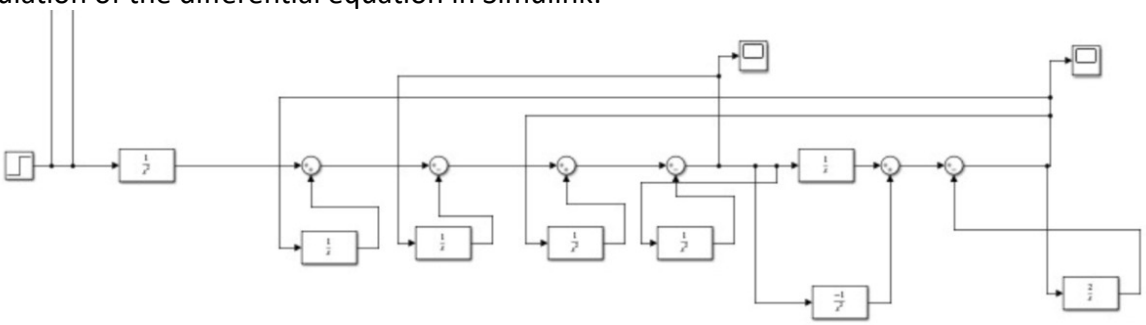
Question 1)



Simulation of the differential equation in Simulink:



We supposed that m1 = m2 = 1kg and k1 = k2 = B = 1

The differential equations are as follow:

Y1(s) = -Y1(s) * (2B/s * m1) + Y2(s) * (B/m1 * s) -Y1(s) * (K1 – K2)/m1* s^2 - Y2(s) * K2/m1 * s^2
Y2(s) = U(S) * (1/m2 * s^2) + Y1(S) * (B / s * m2) – Y2(S) * (B/s * m2) + Y1(S) * (K2/ m2 * s^2) – Y2(S) * (K2/ m2 * s^2)
Also the TF between Y1(s) and U(S) Is as follow:
Y1(s) / U(S) = (s – 1) / (s^4 + 3s^3 + 2s^2 + 2*s + 1)

The TF between Y2(S) and U(S) is as follow:

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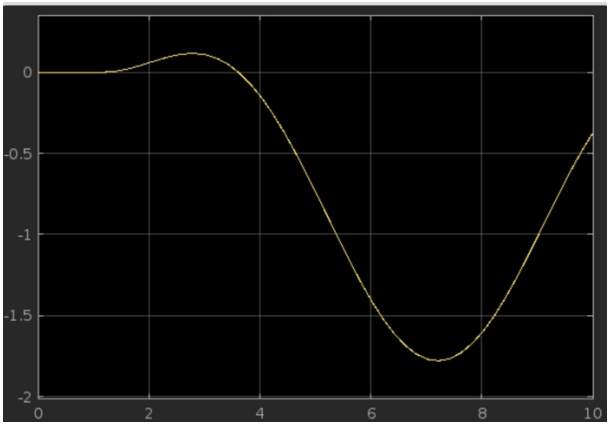
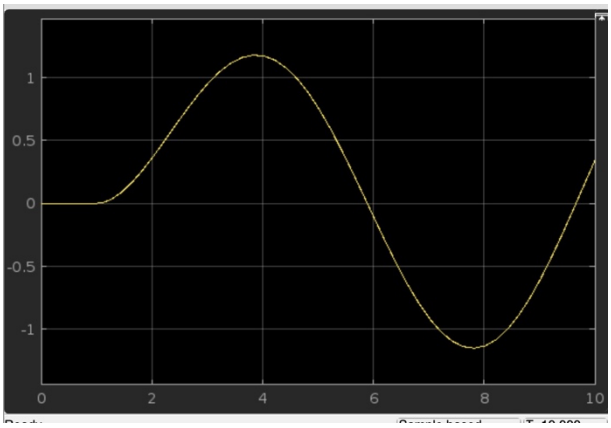
Y2(S)/ U(S) = (s^2 + 2s) / (s^4 + 3 s^3 + 2s^2 + 2S + 1)

The results of Y1(s) and Y2(S) from simulation is as follow:

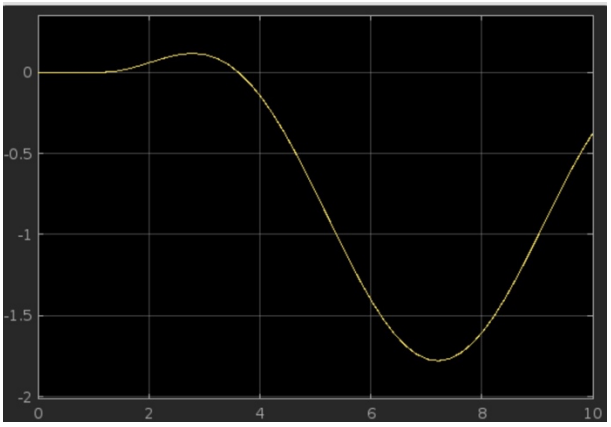


Y1(S) result from simulation

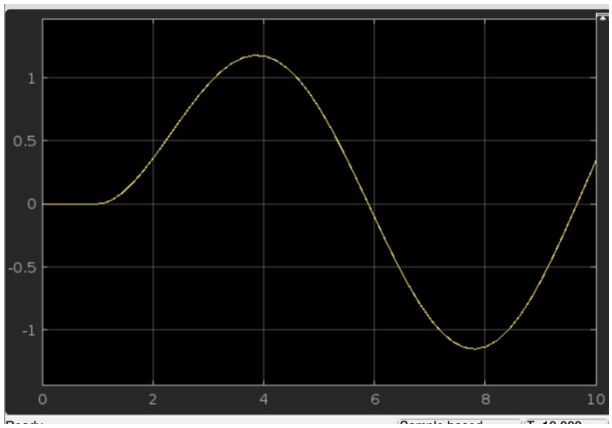


Y2(S) result from simulation

The results of Y1(s) and Y2(S) from TF scope is as follow:



Y1(S) result from scope



Y2(S) result from scope

The TF diagrams is as follow:

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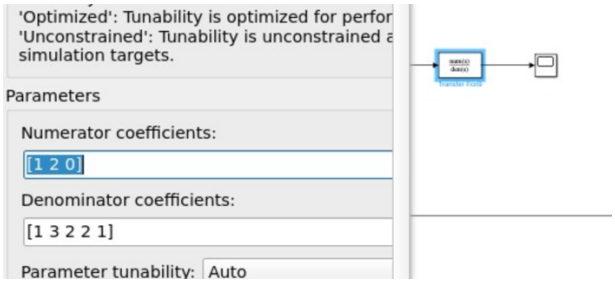
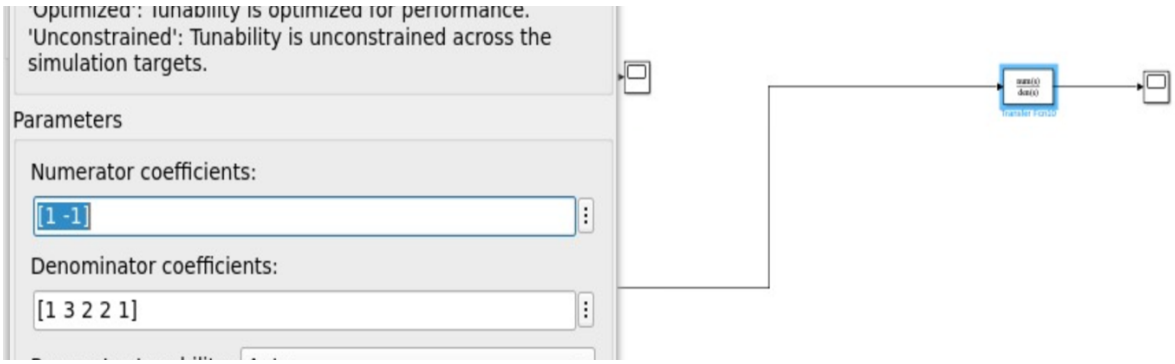


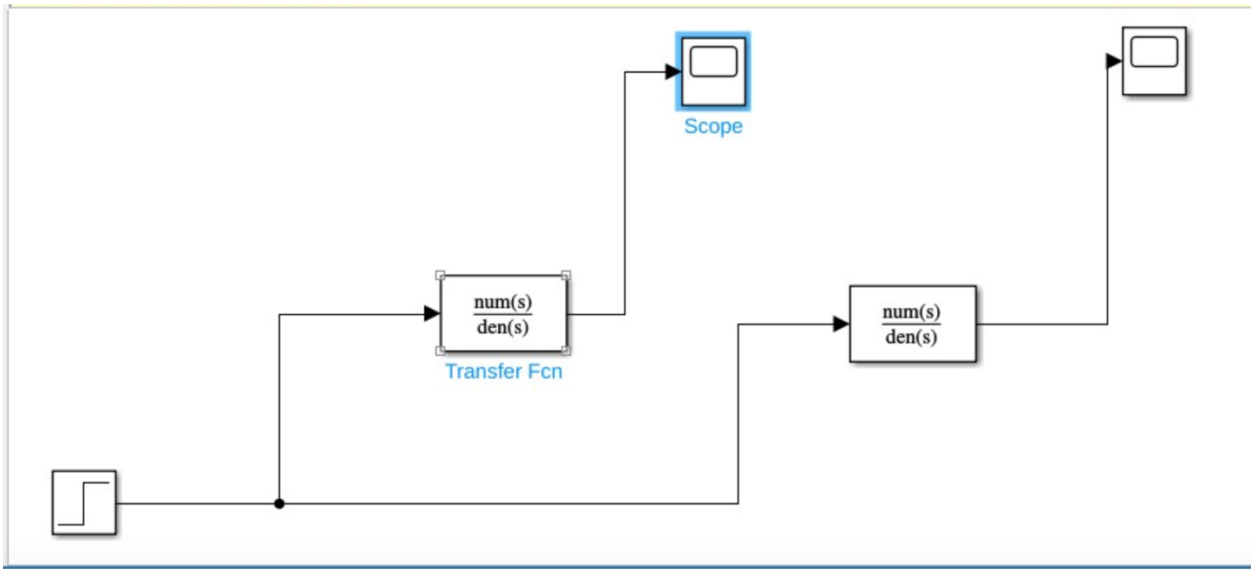
Y2(S)/ U(S)



Y1(S) / U(s)

As is obvious the Y1(s) and Y2(s) are both same from the scope result and simulation result. Y1(s) indicates that m1 starts to go before the initial point and then coming back to it. In contrast, Y2(s0 indicates that m2 starts to go after initial point and then come back to it.

Question 2)



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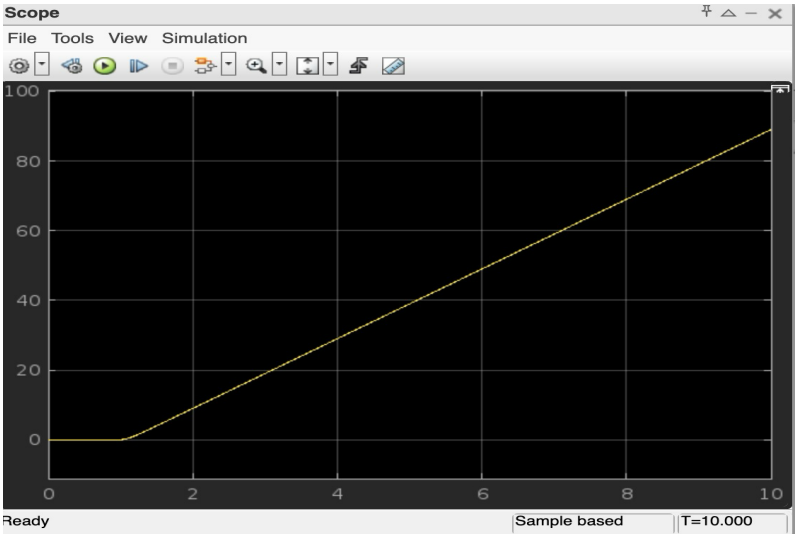
Formula :
Theta(S) / T(S) = 1 / (Is^2 + bs)

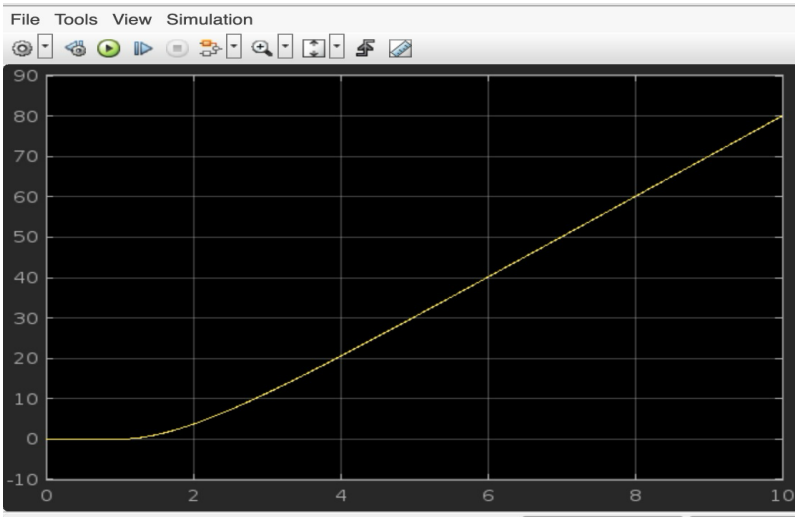
Reference for the Damping of the mechanical system (b) :
https://www.maplesoft.com/support/help/maple/view.aspx?path=applications%2FDCMotor

Here b is 0.1

Inertia: 0.01 result:



Inertia = 0.1 result:



As can be seen, the higher inertia result in lower slope of change in the Theta, and the lower inertia ends up in higher slope of change in Theta.