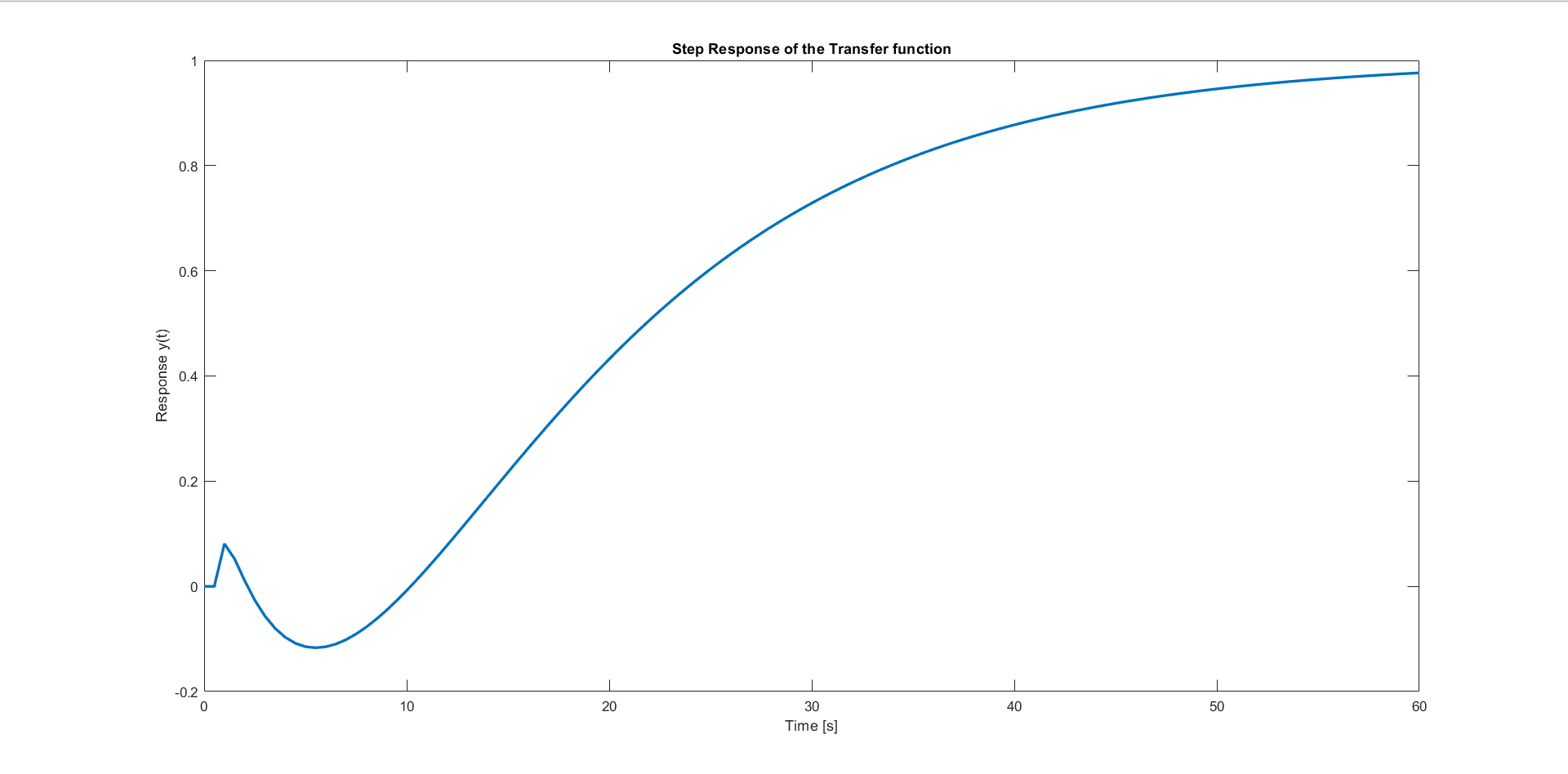
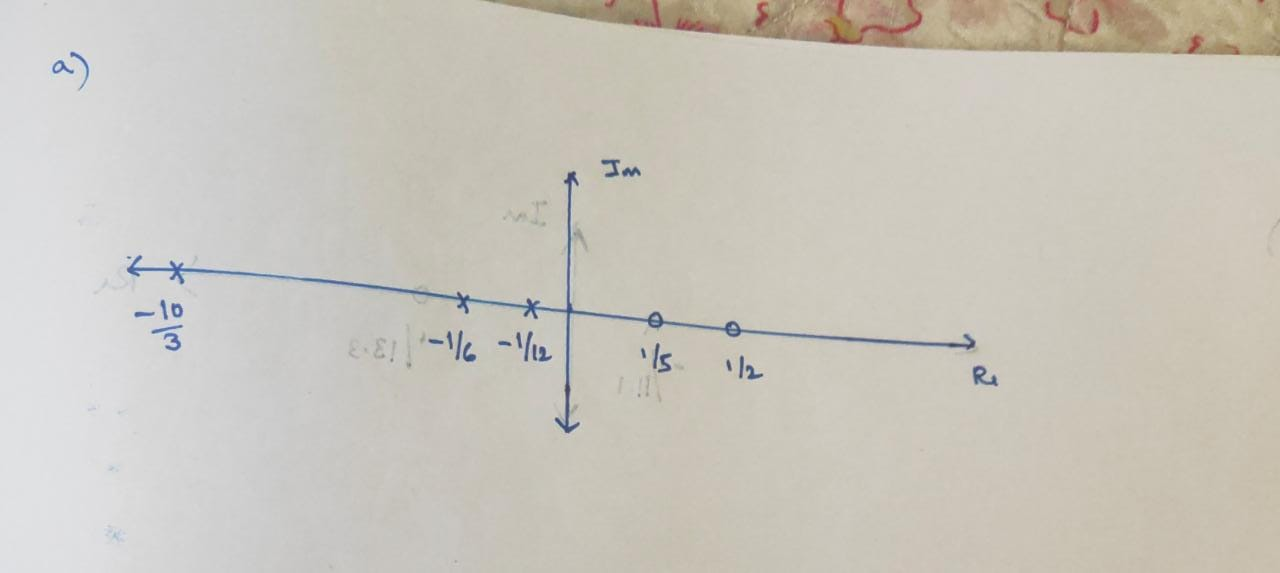
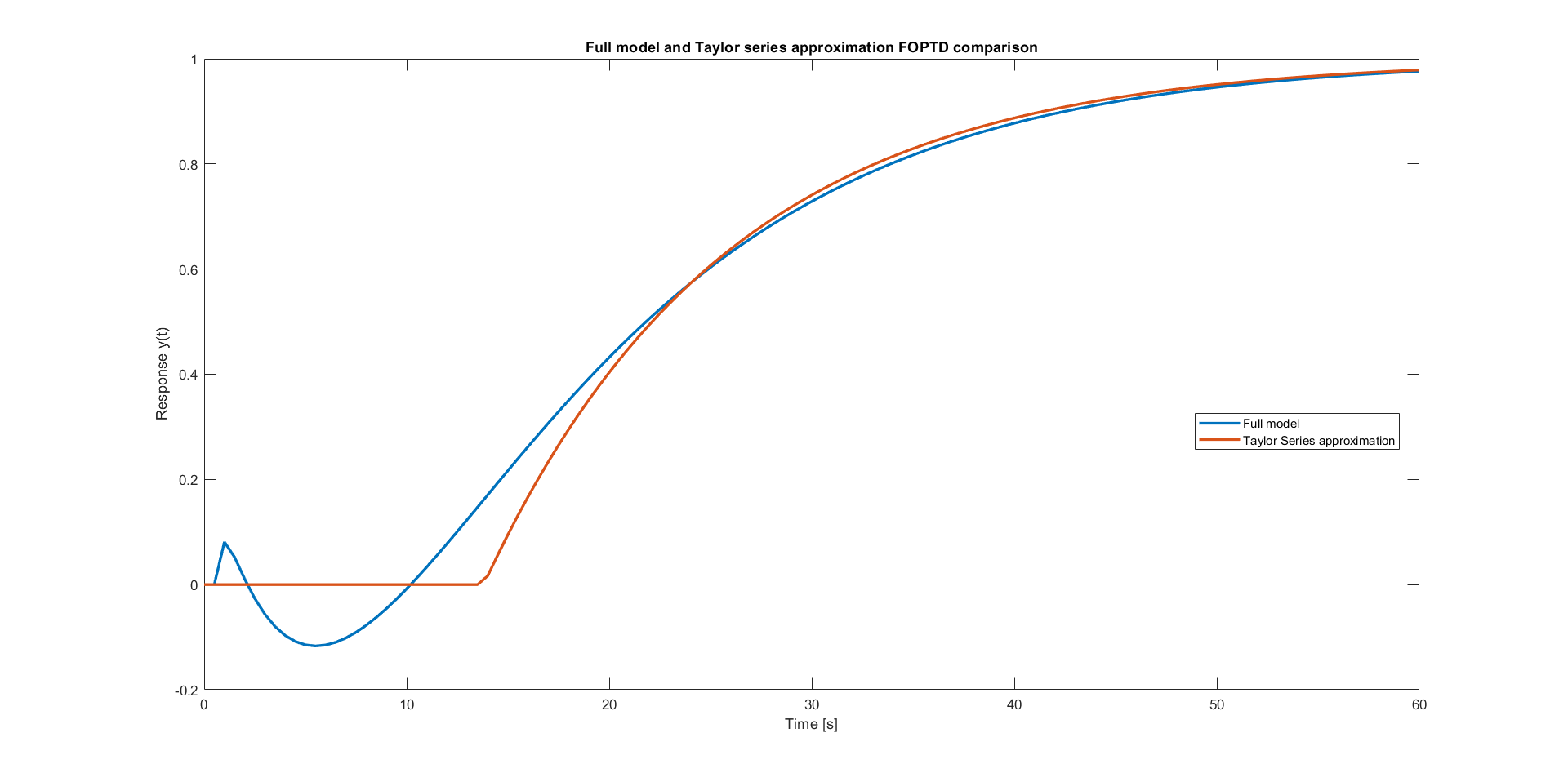
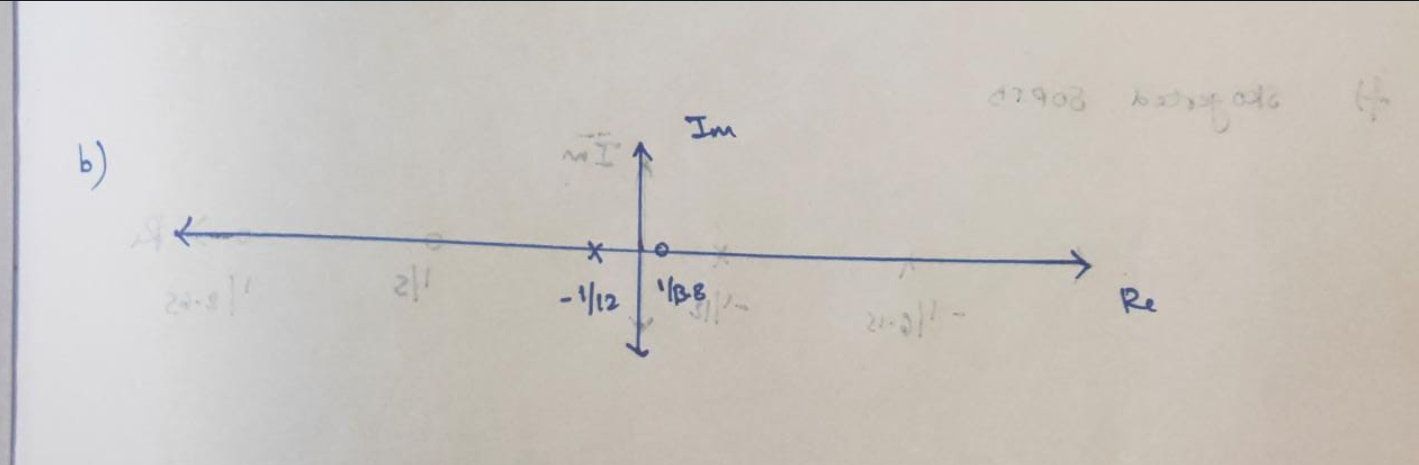
Q1) (Approximated time delay by taylor for the zeros)

a) 

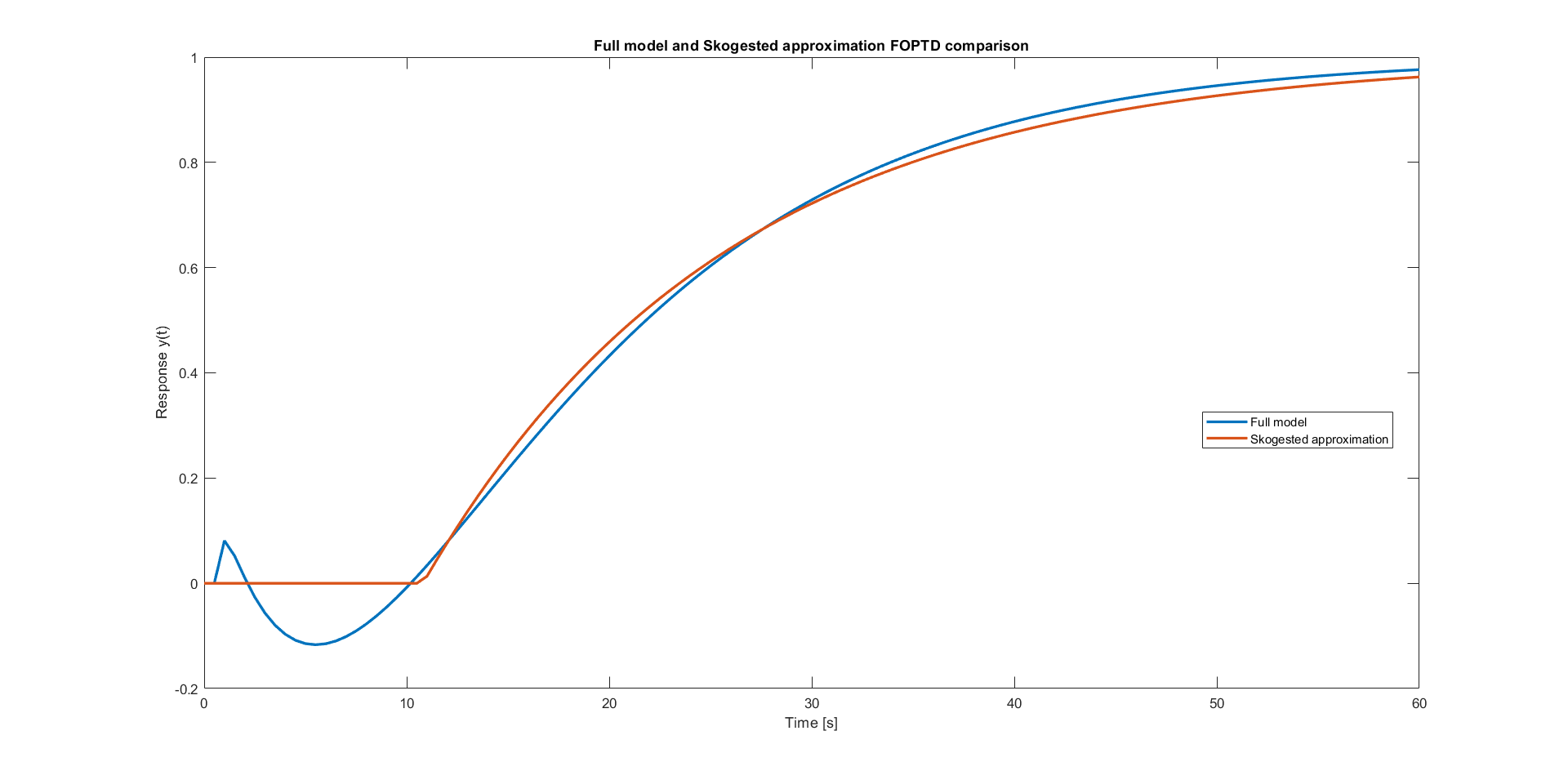


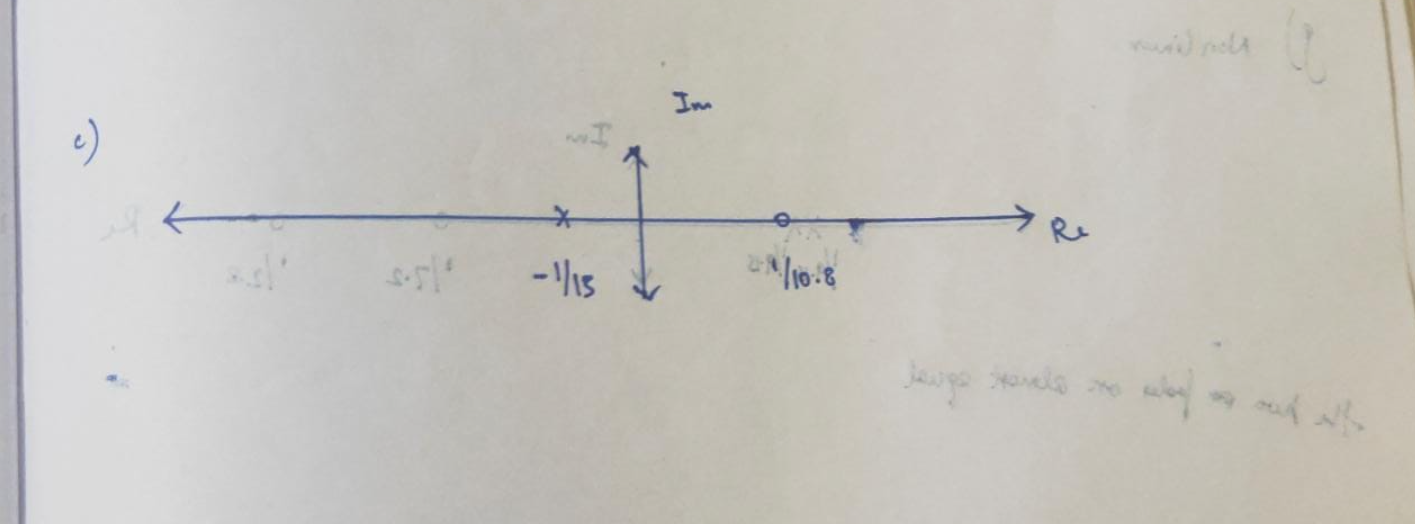
b)



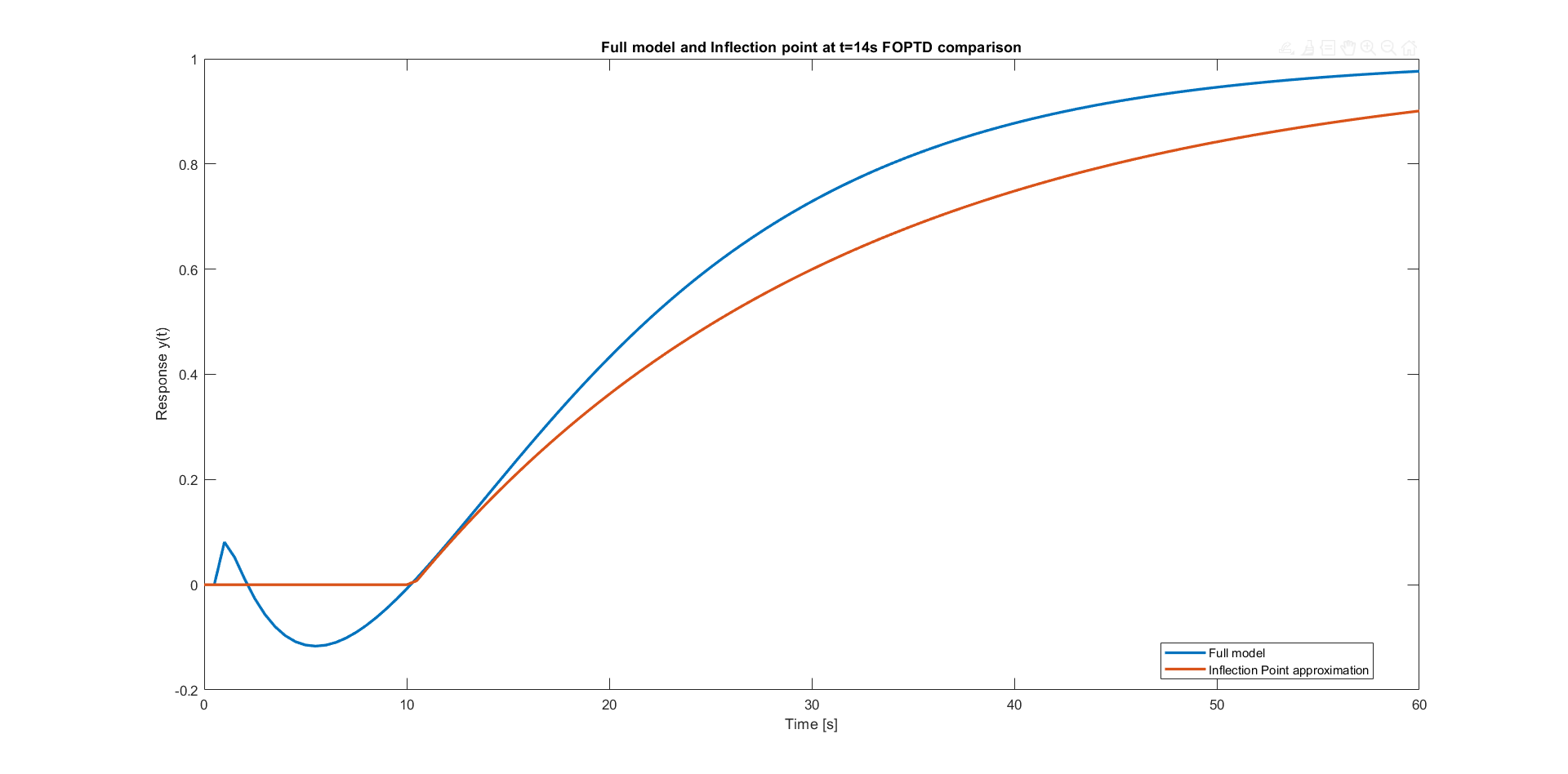


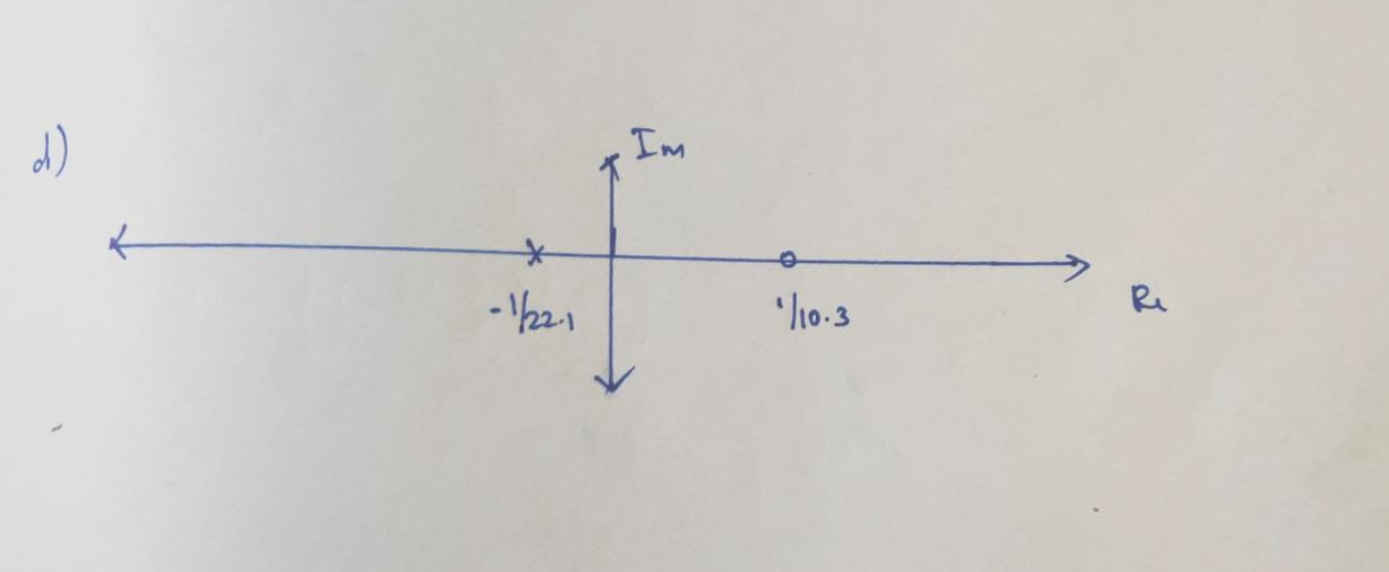
c)

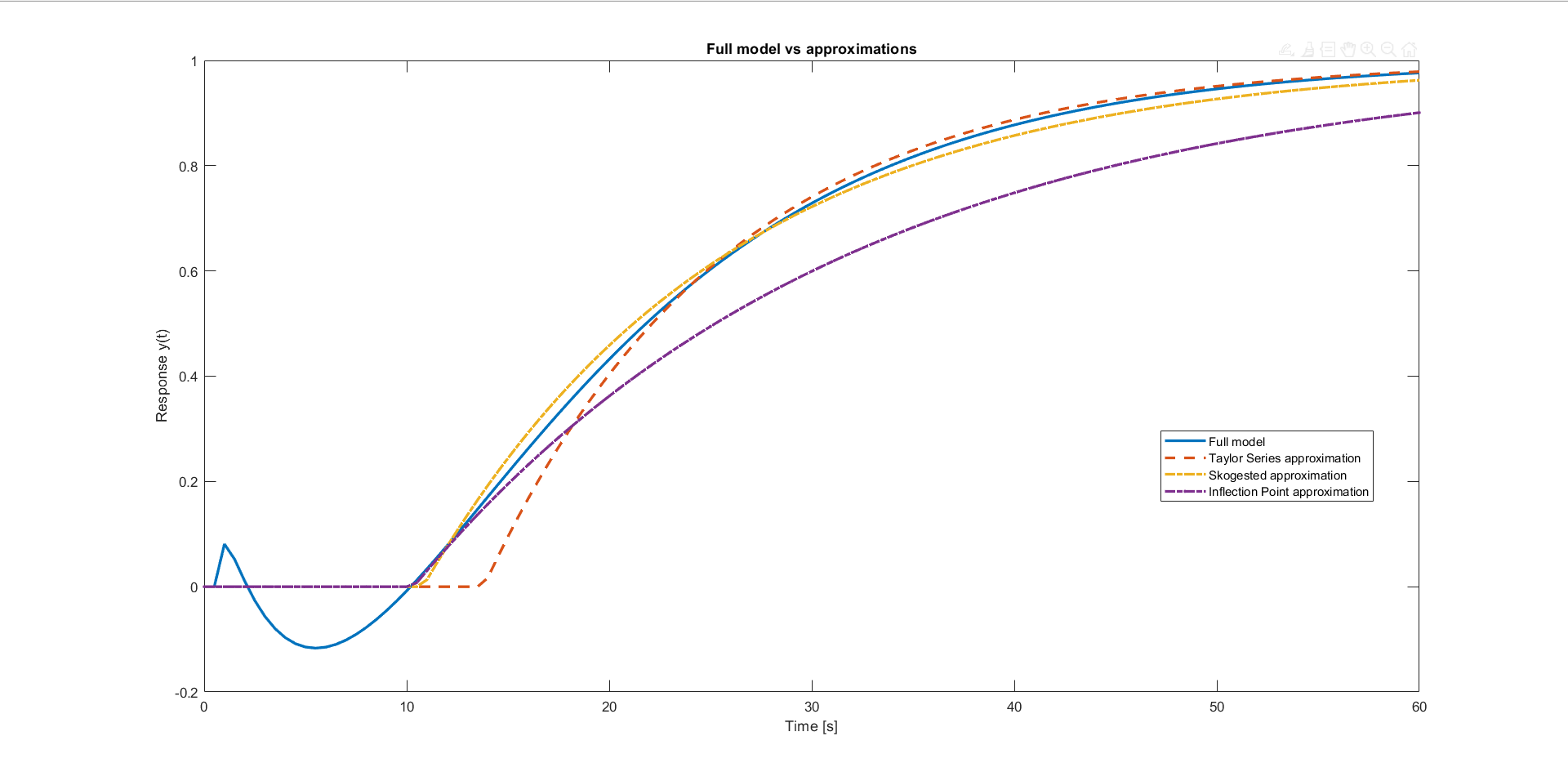


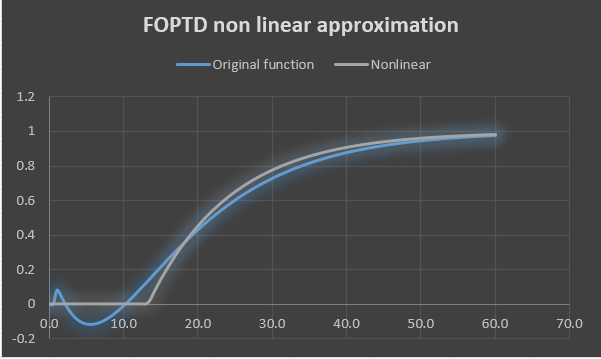


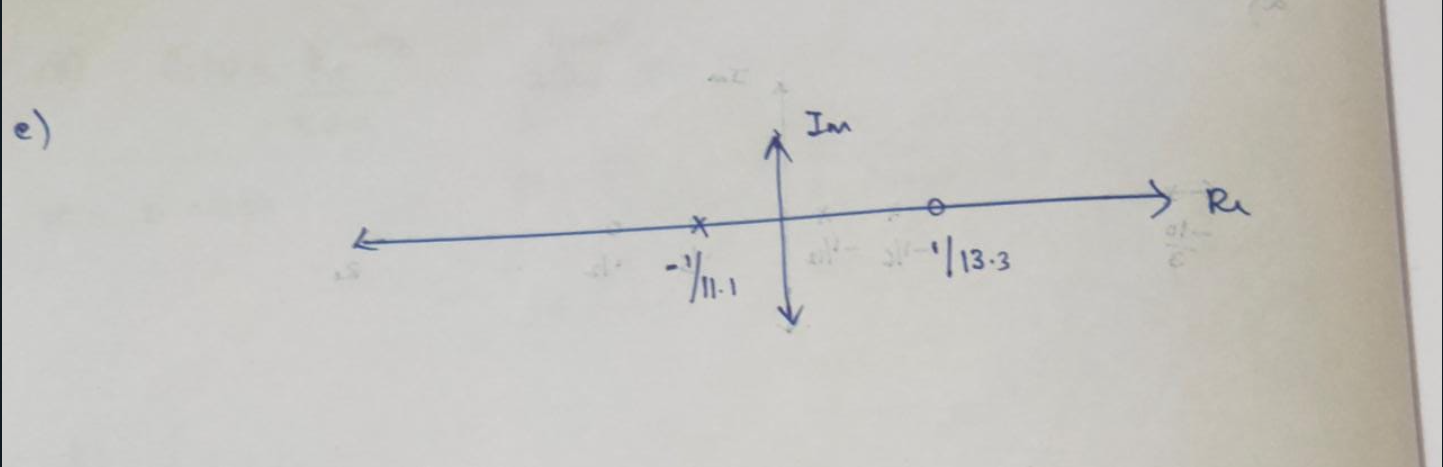
d)

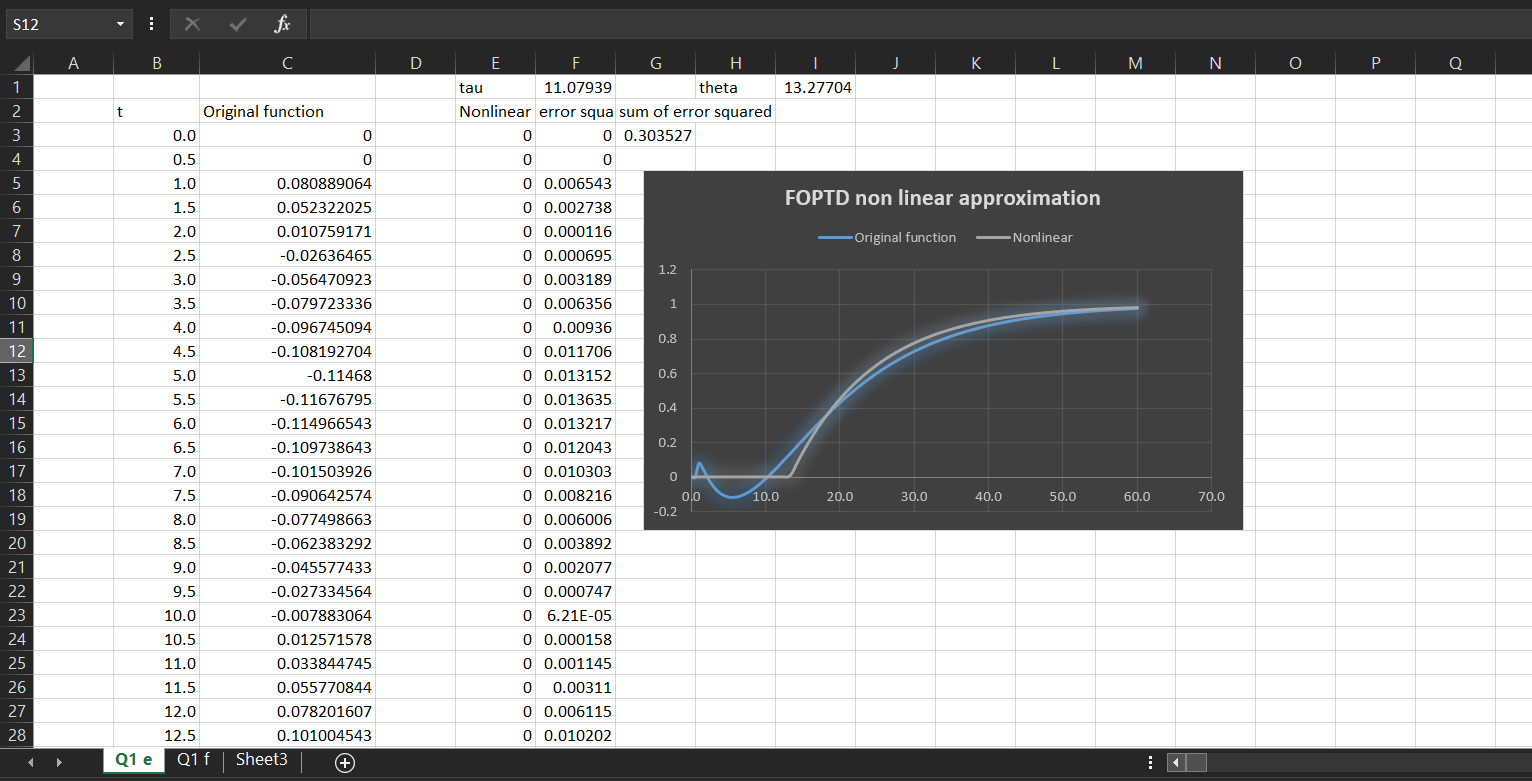


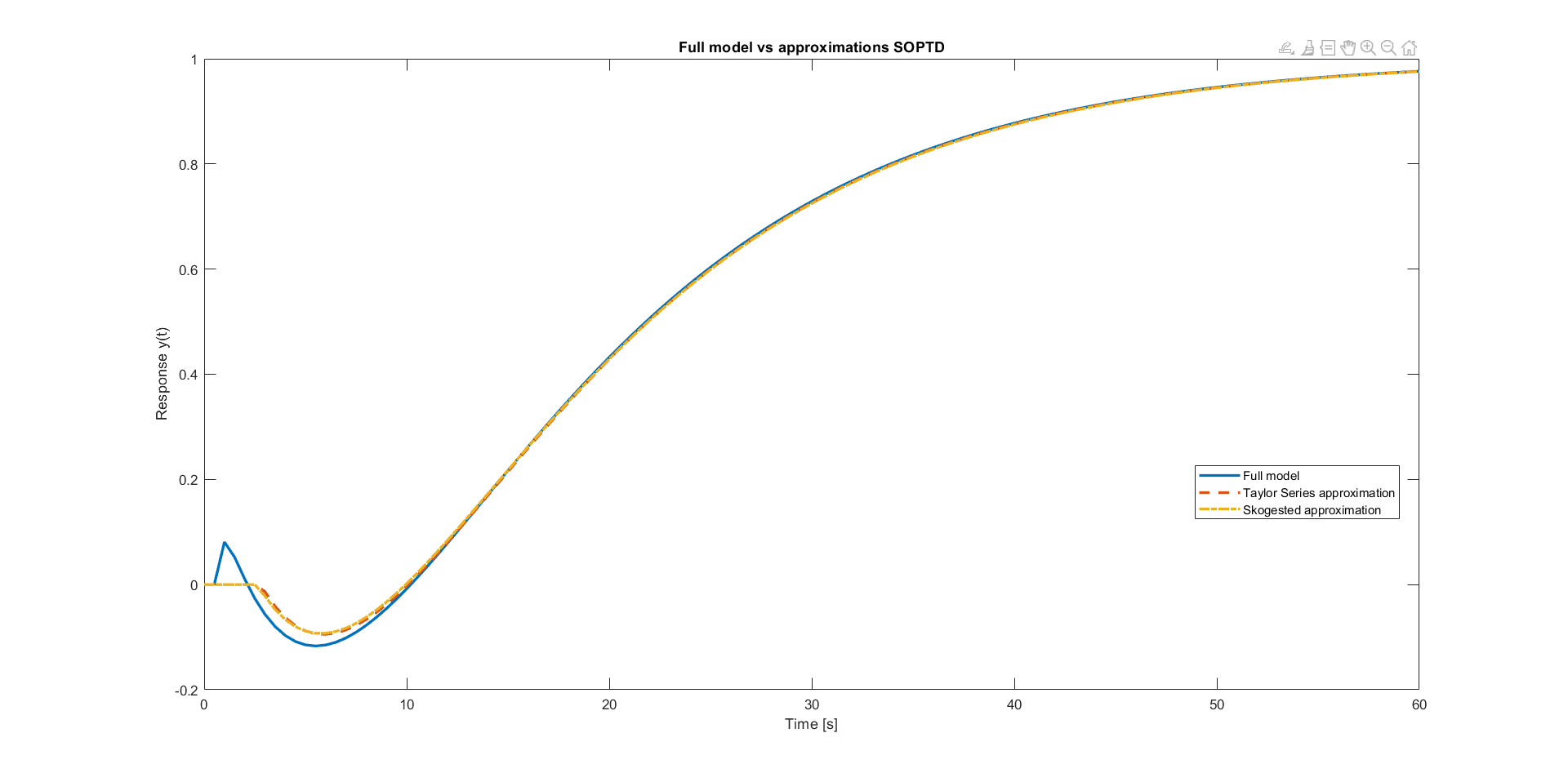


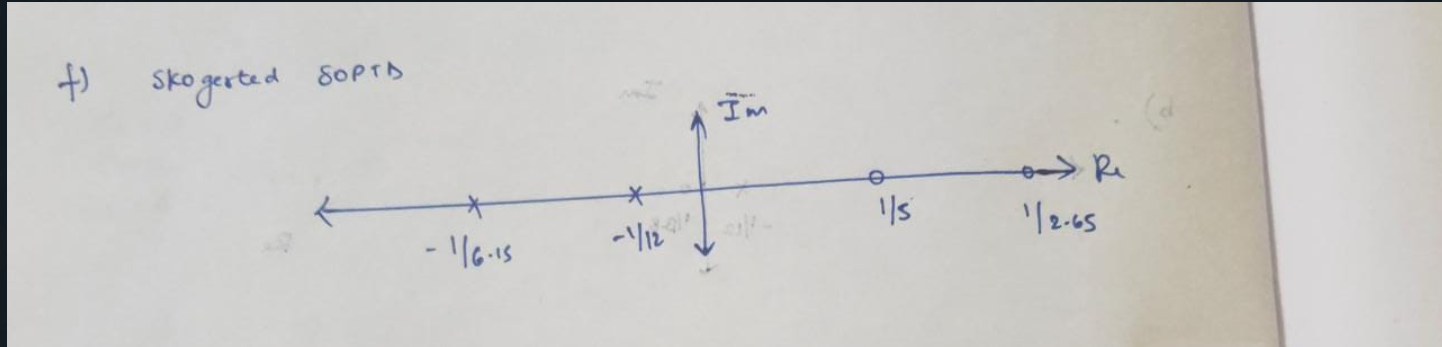


e) 

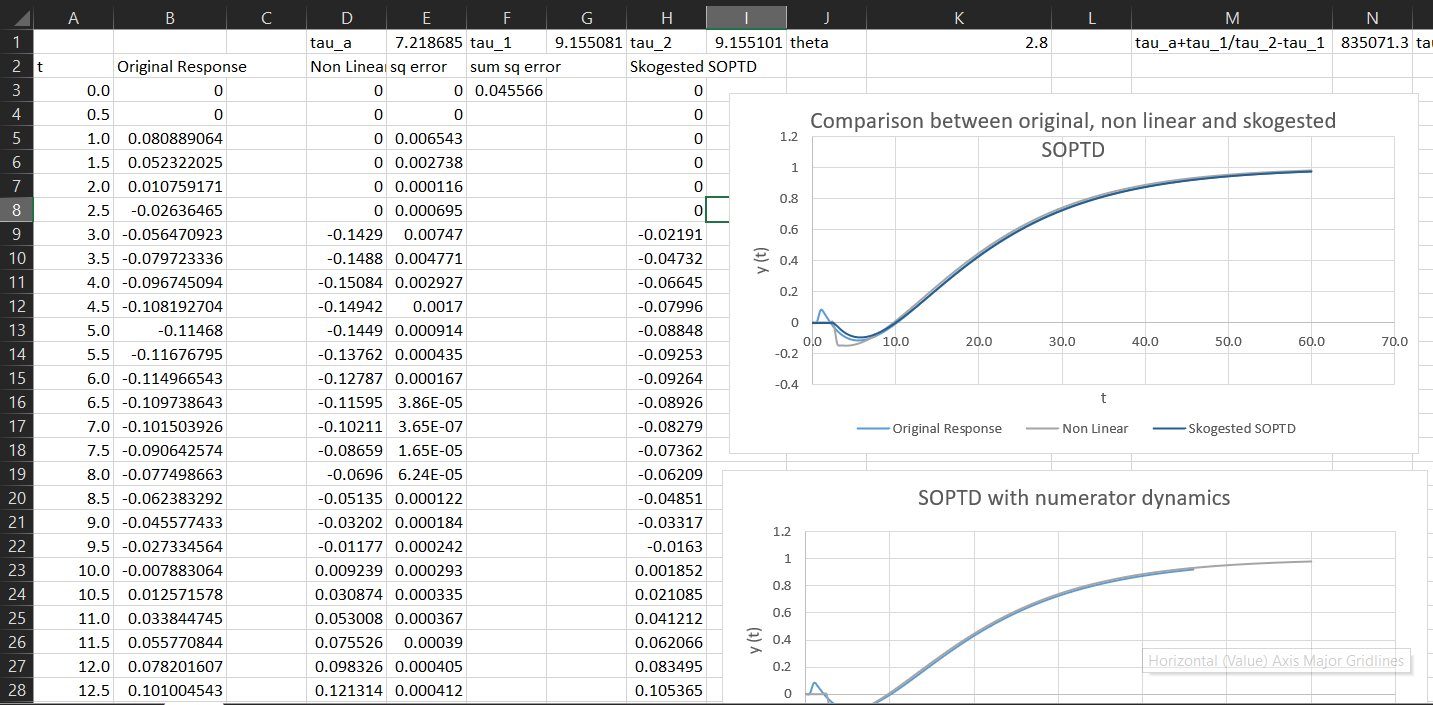


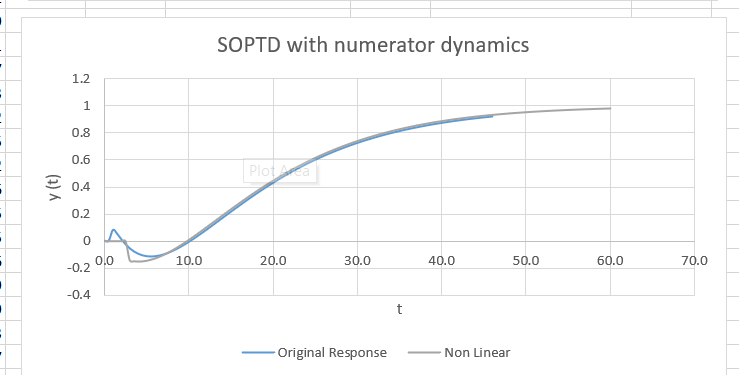


f) 

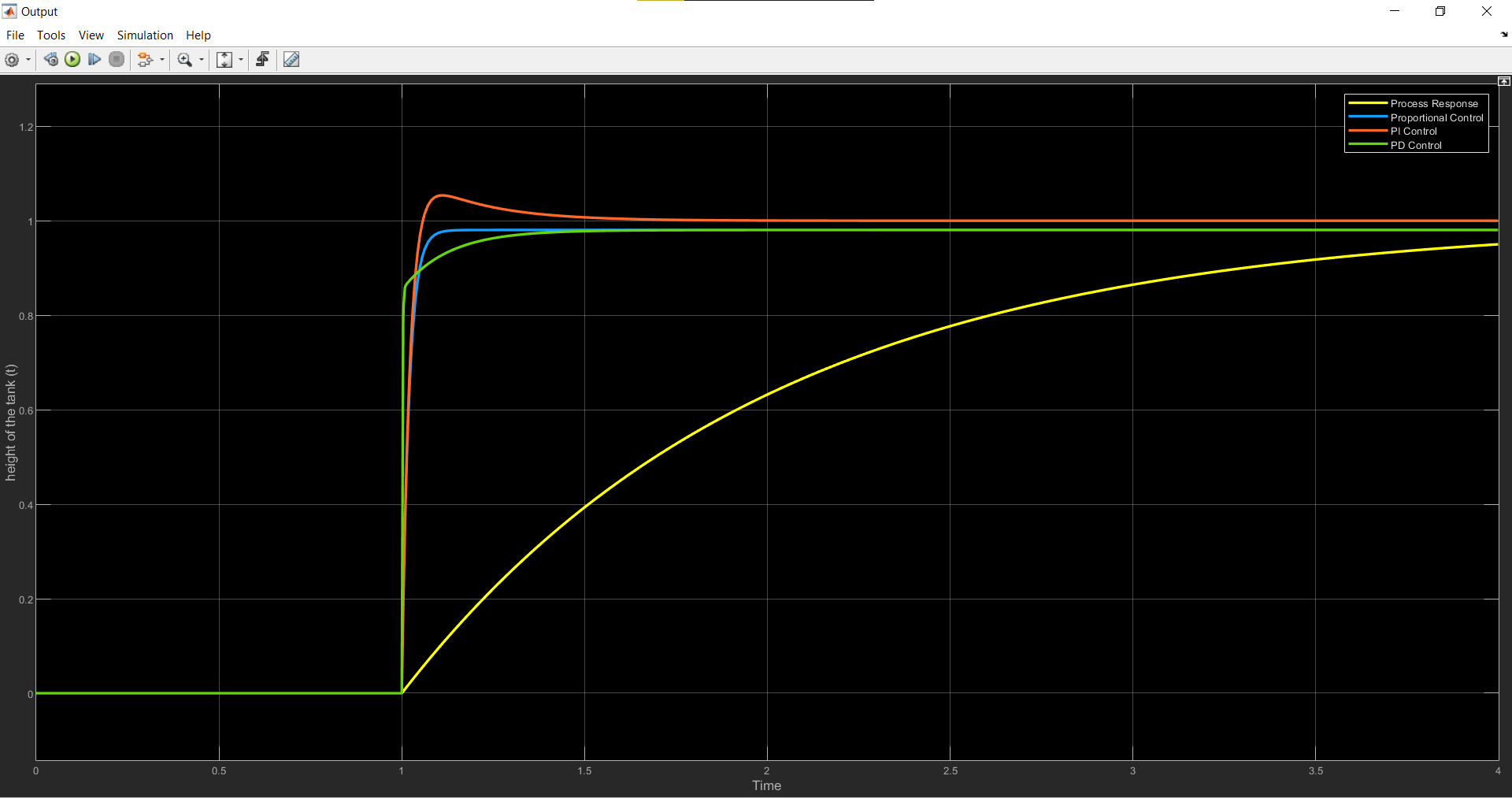


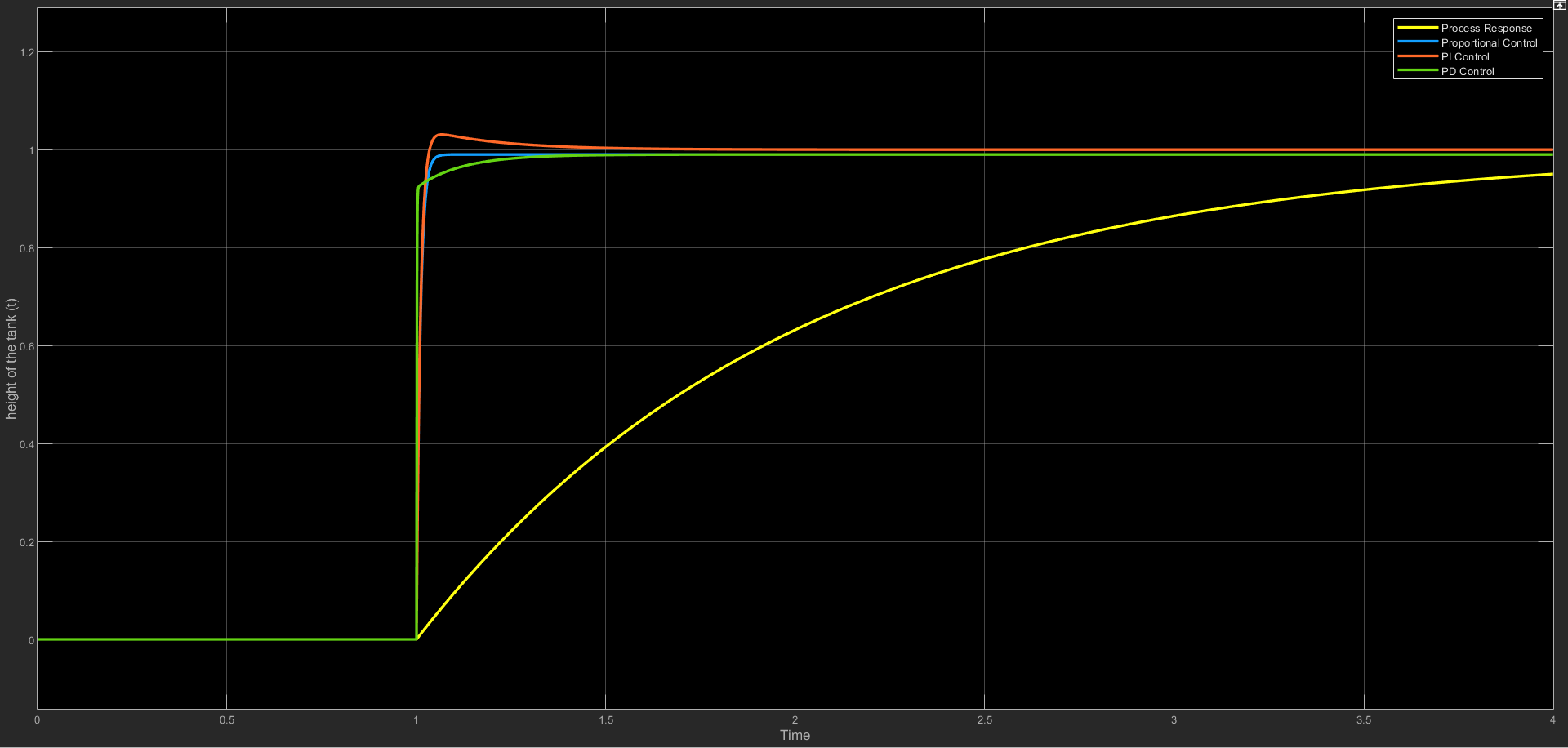
g)

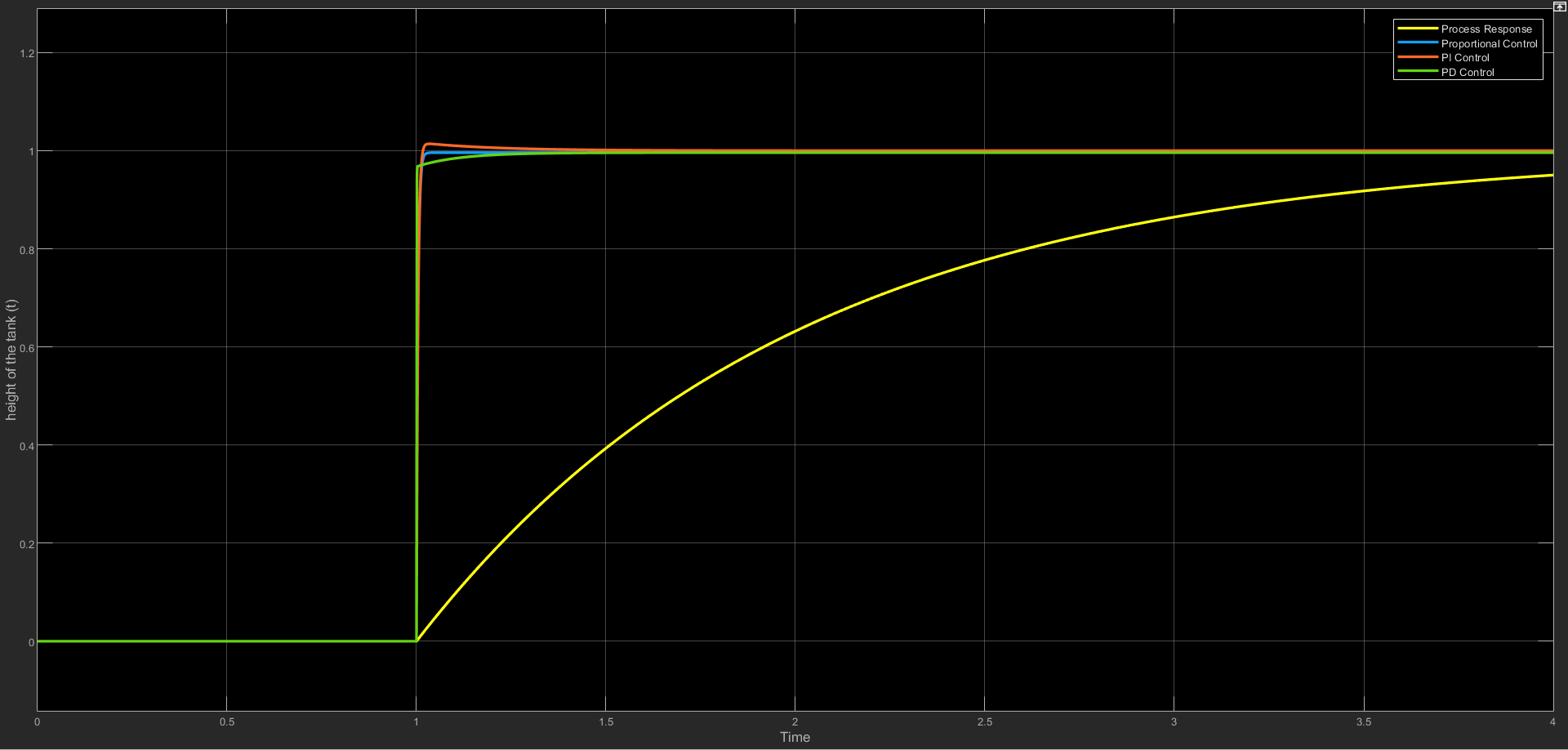




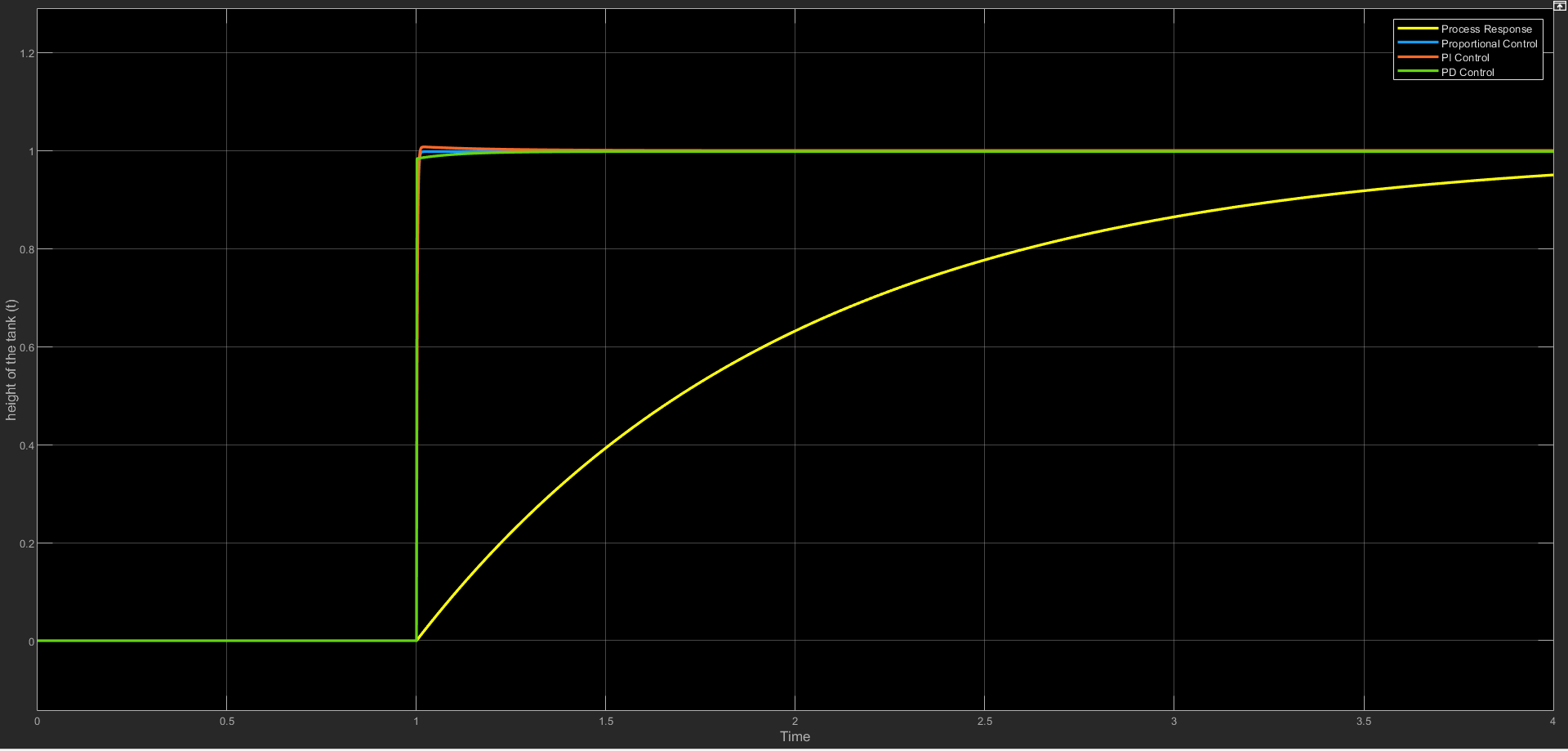
Q2)

K=50

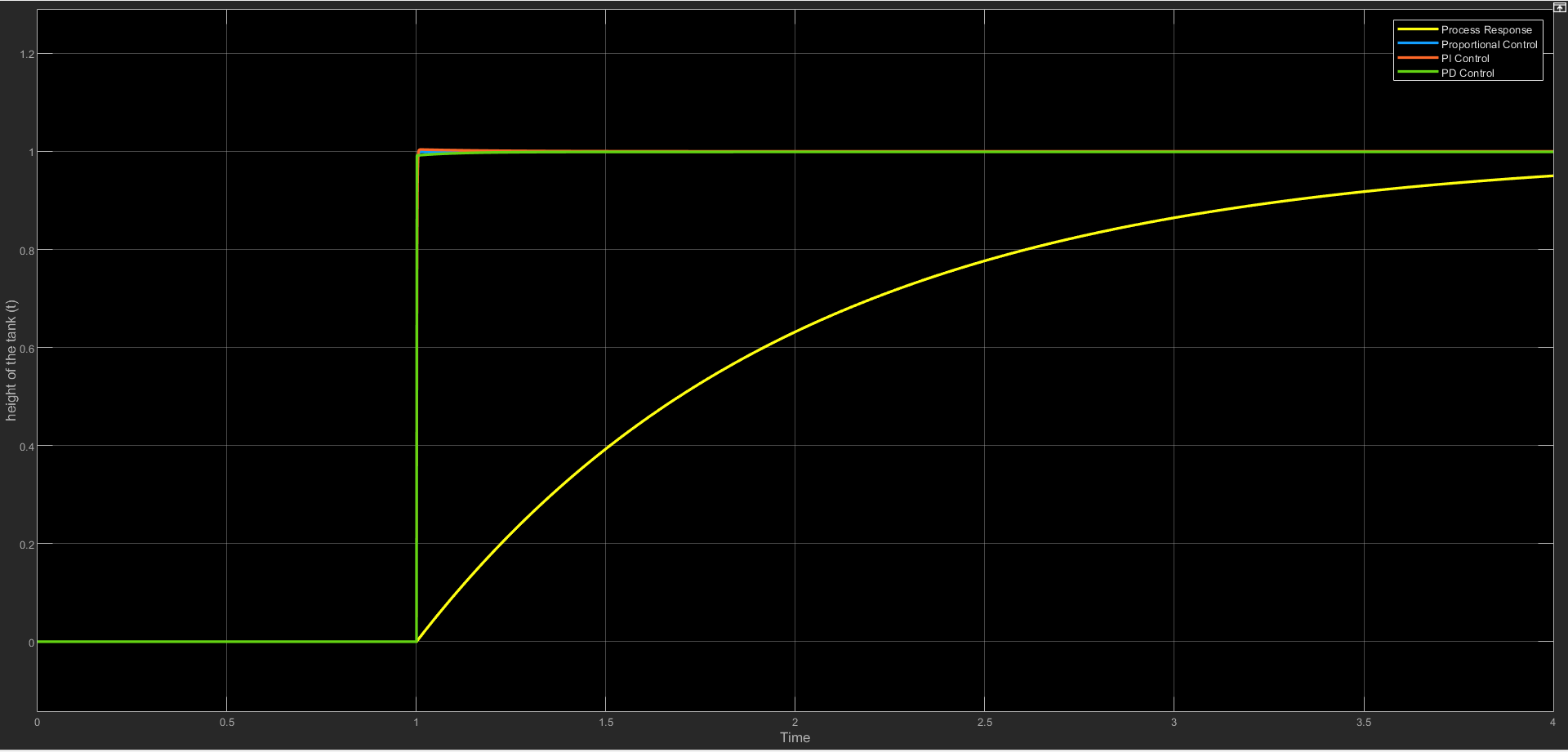
K=100



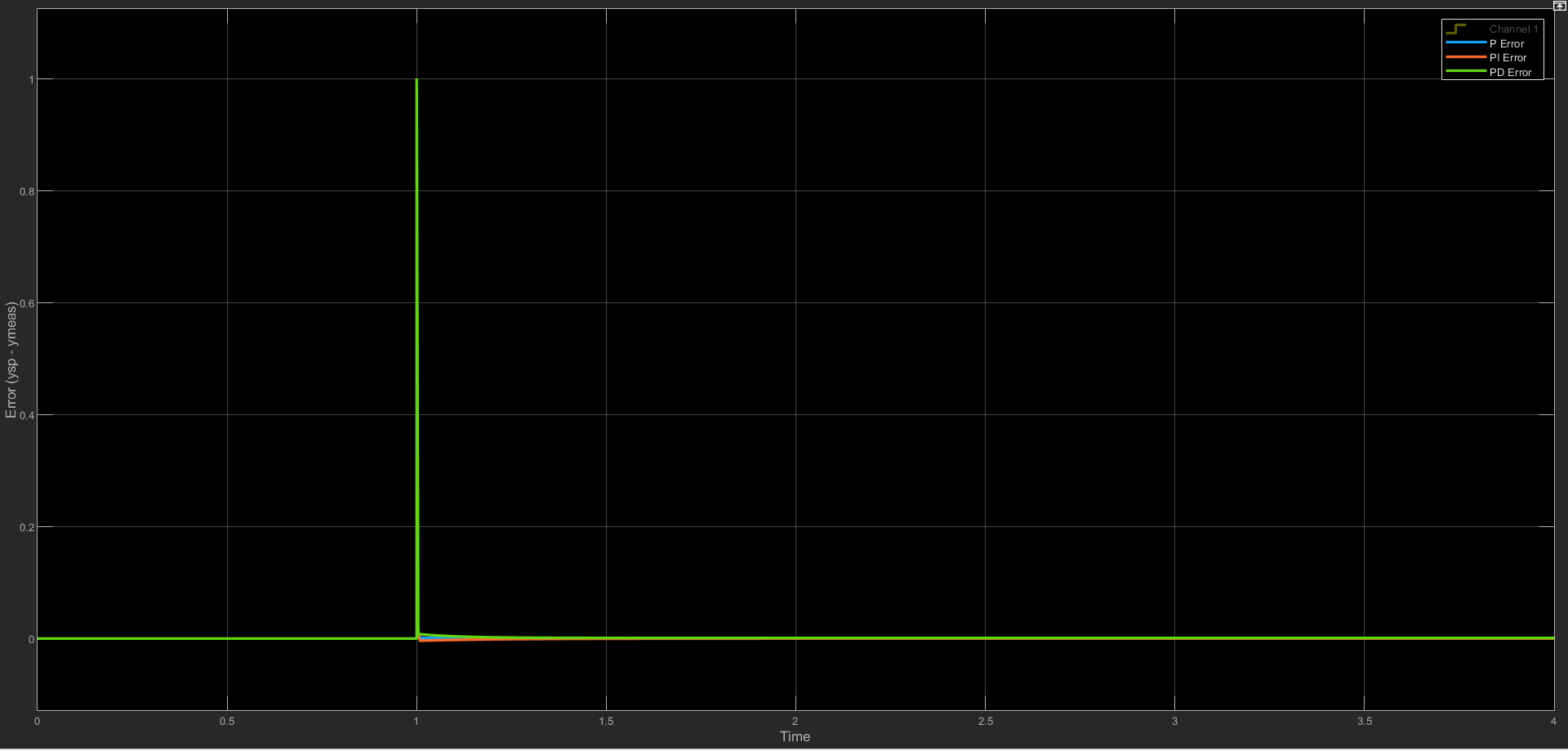
K=250



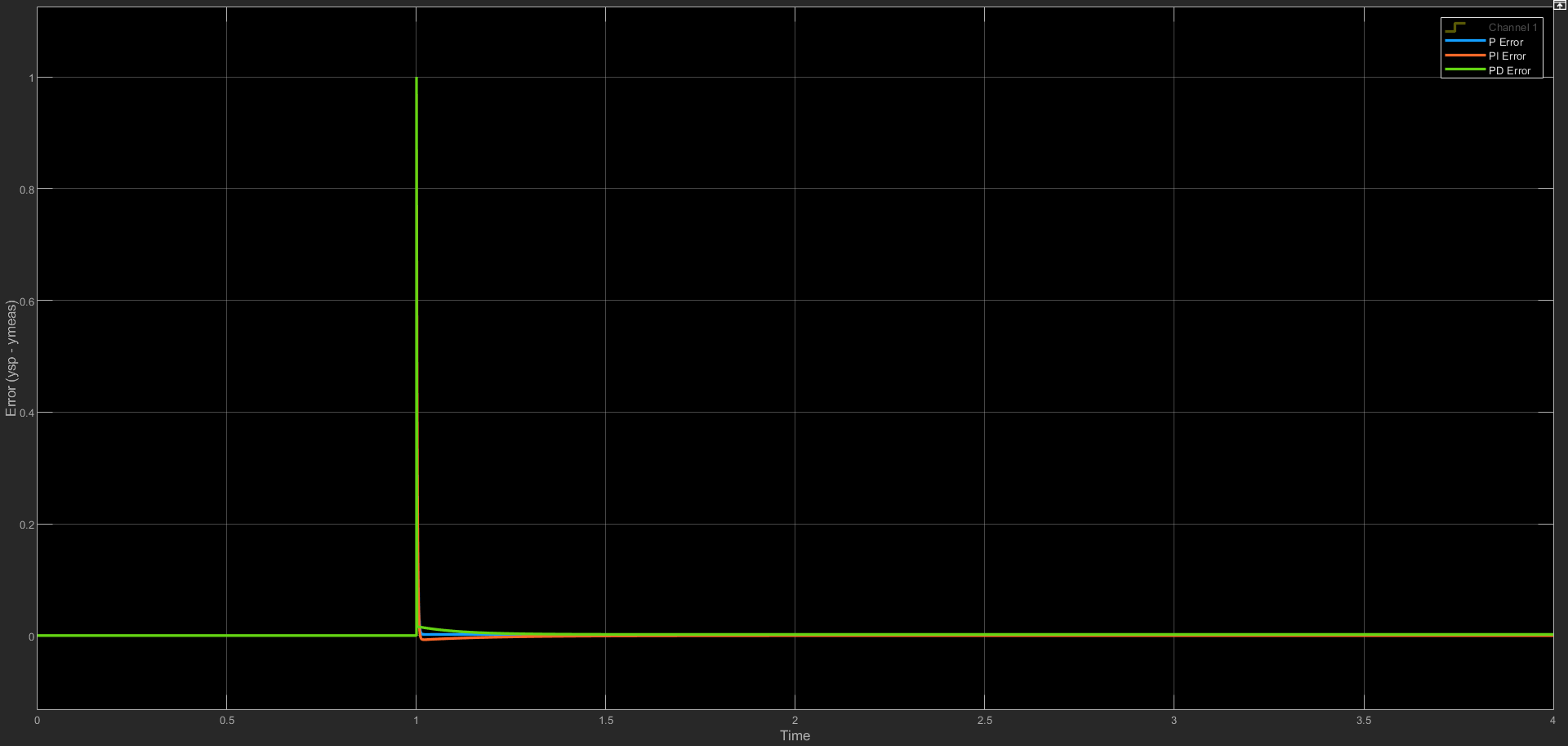
K=500



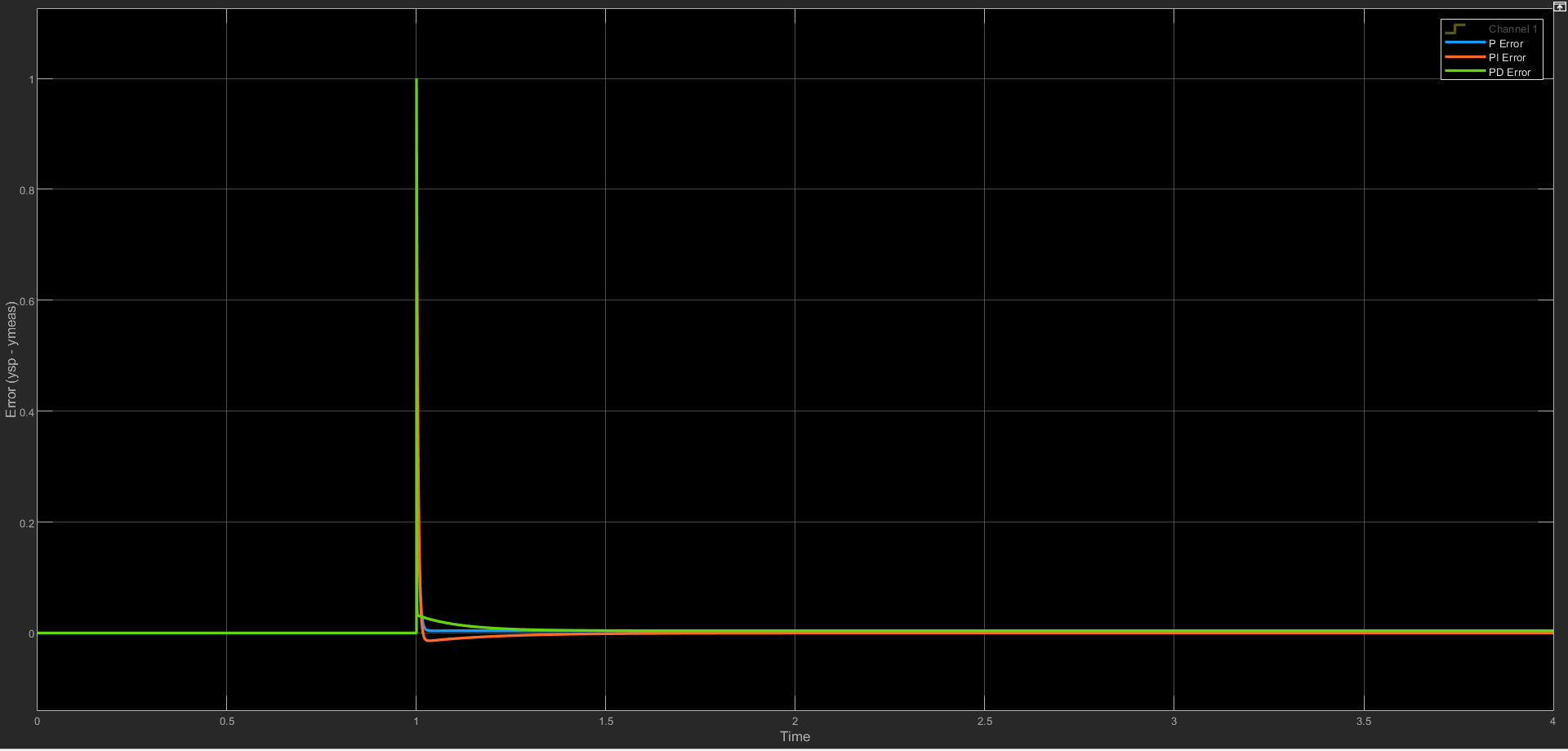
K=1000



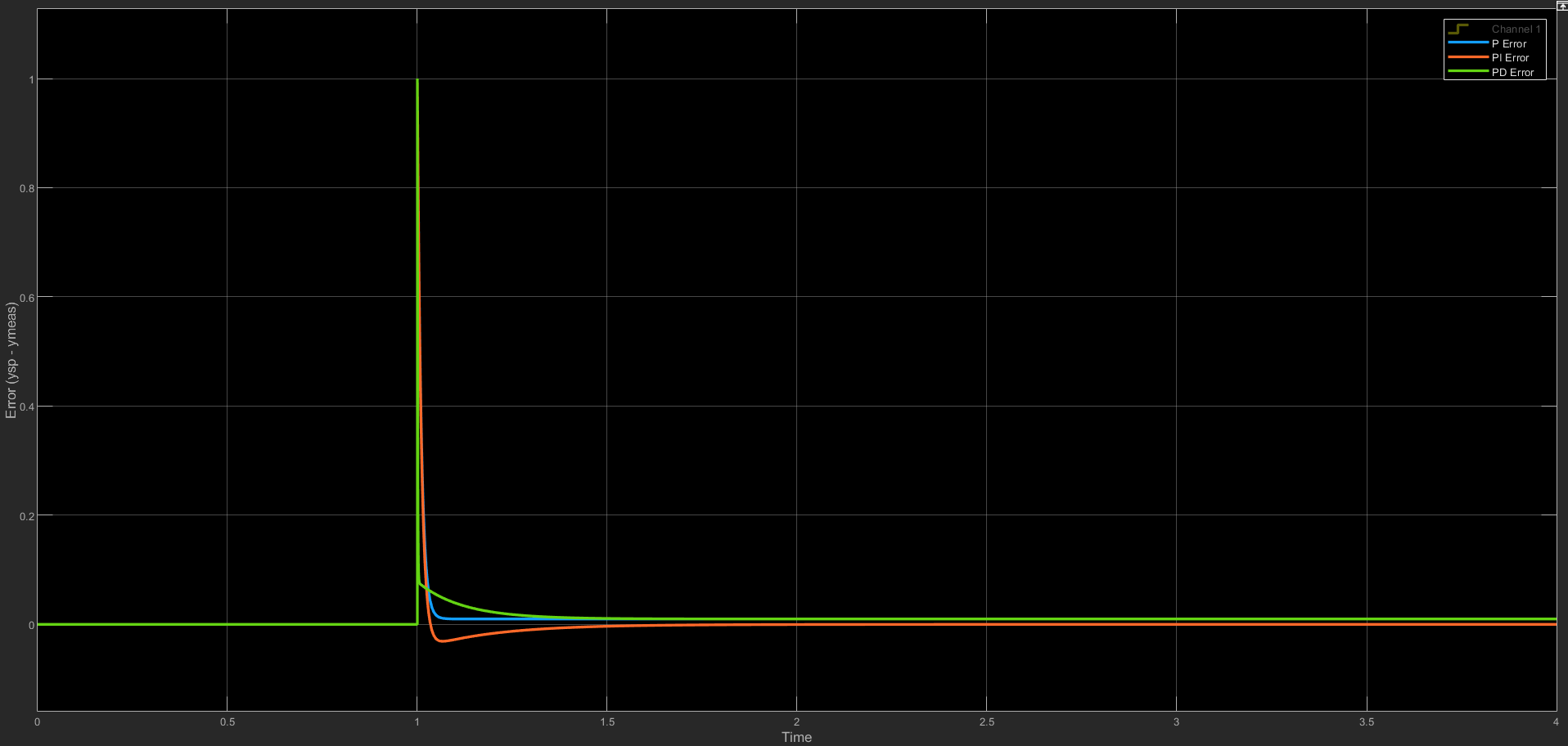
K=1000



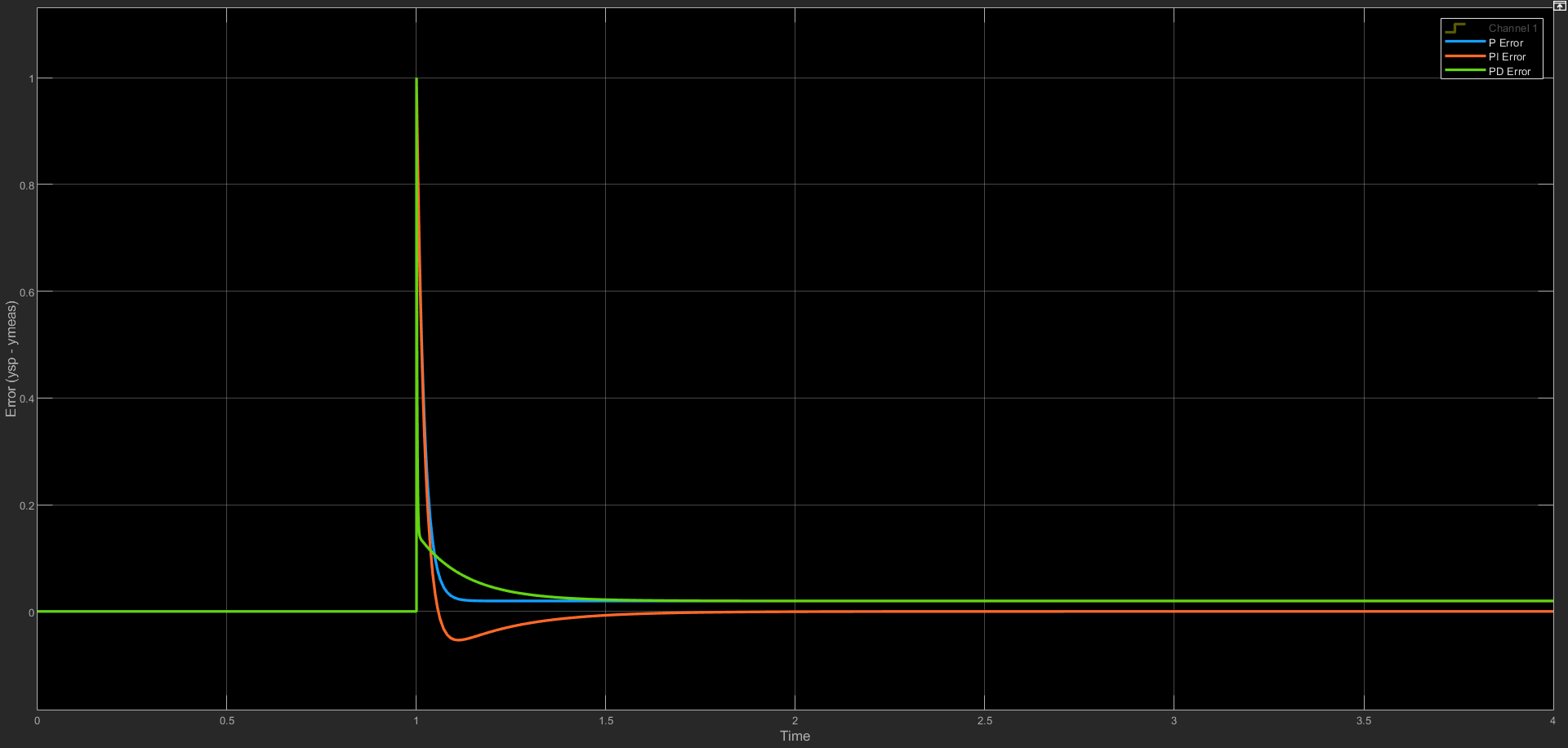
K=500



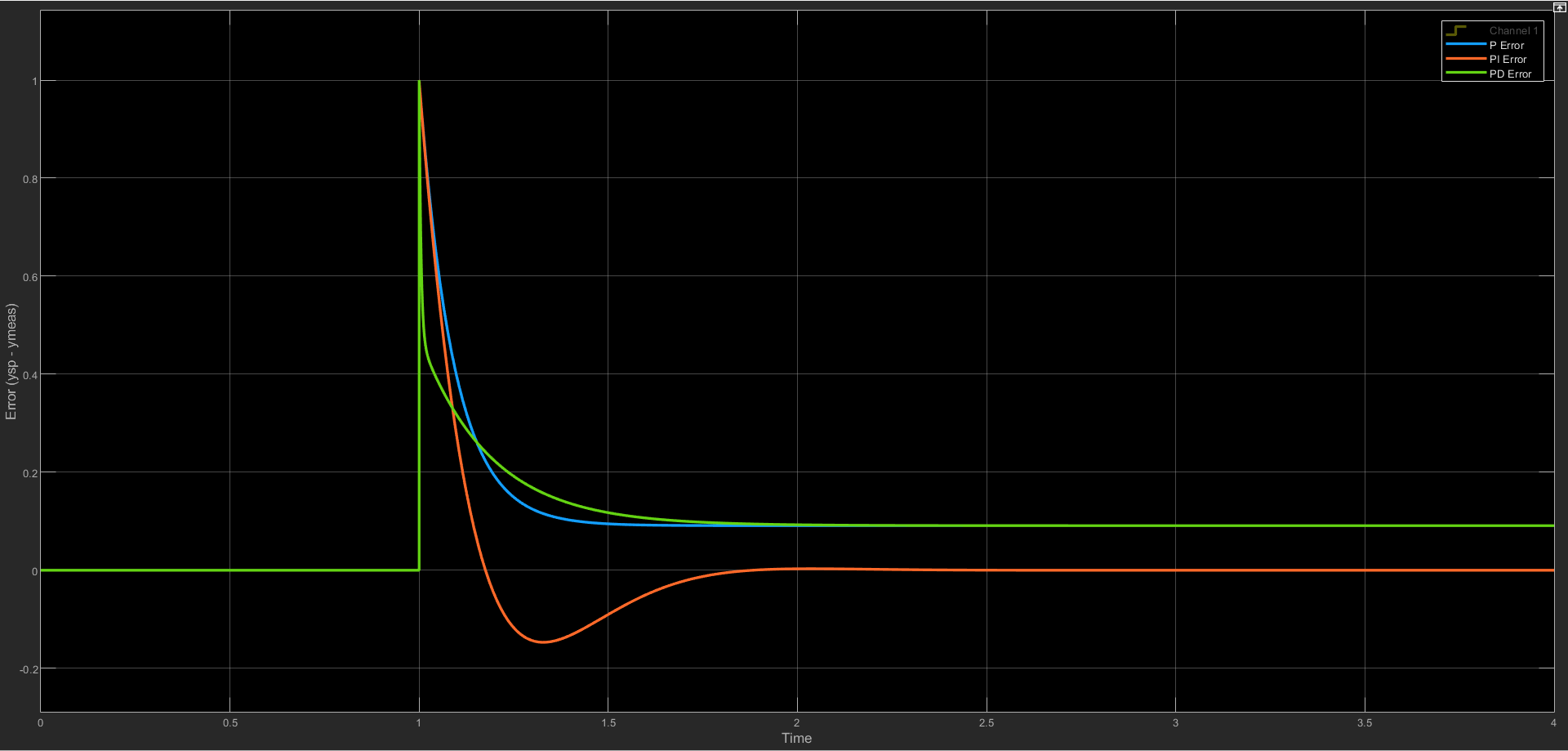
K=250



K=100

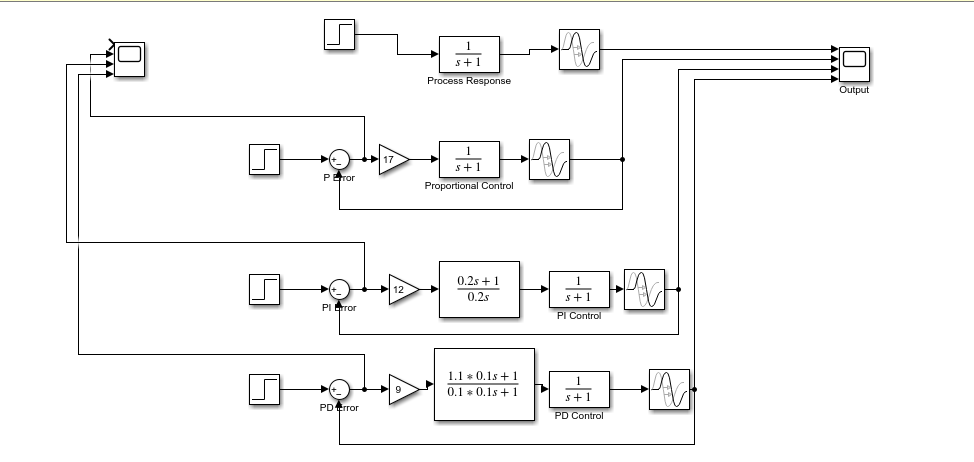


K=50



K=10

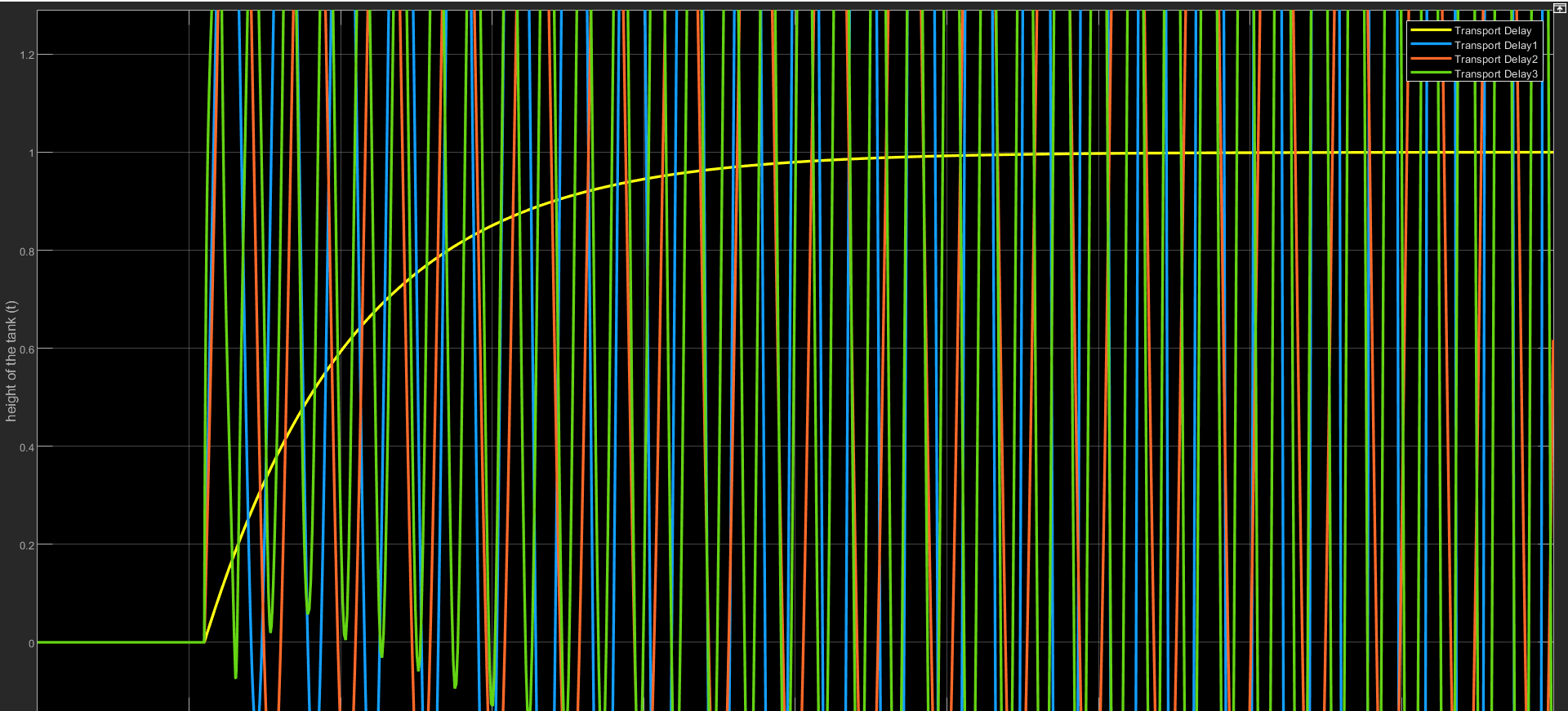
b) P, PI, PD controller together from top to bottom respectively



For P controller the value of Kc >= 16 gives unstable output

For PI controller, the value of Kc >= 12 gives unstable output

For PD controller, the value of Kc >=9 gives unstable output

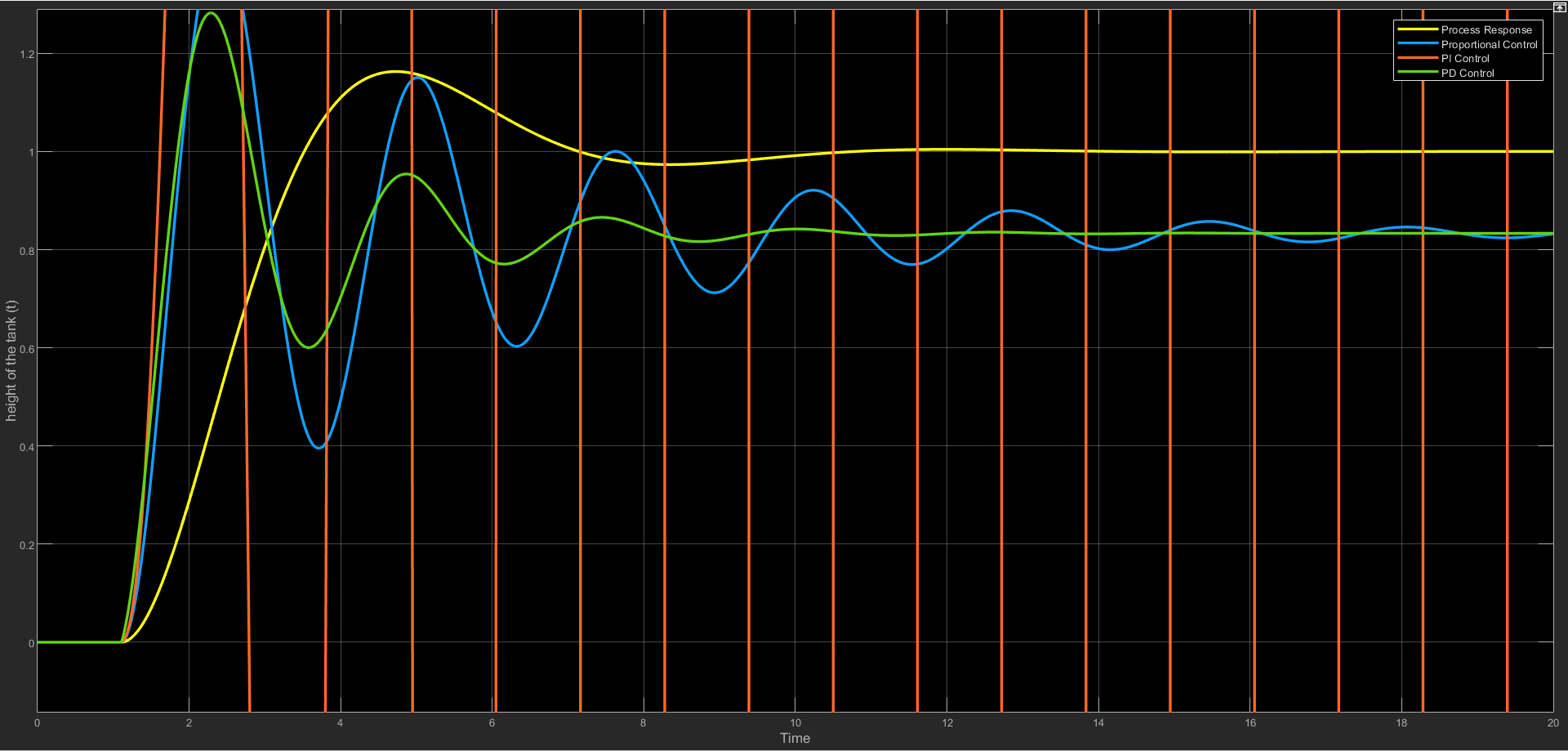


All are unstable outputs

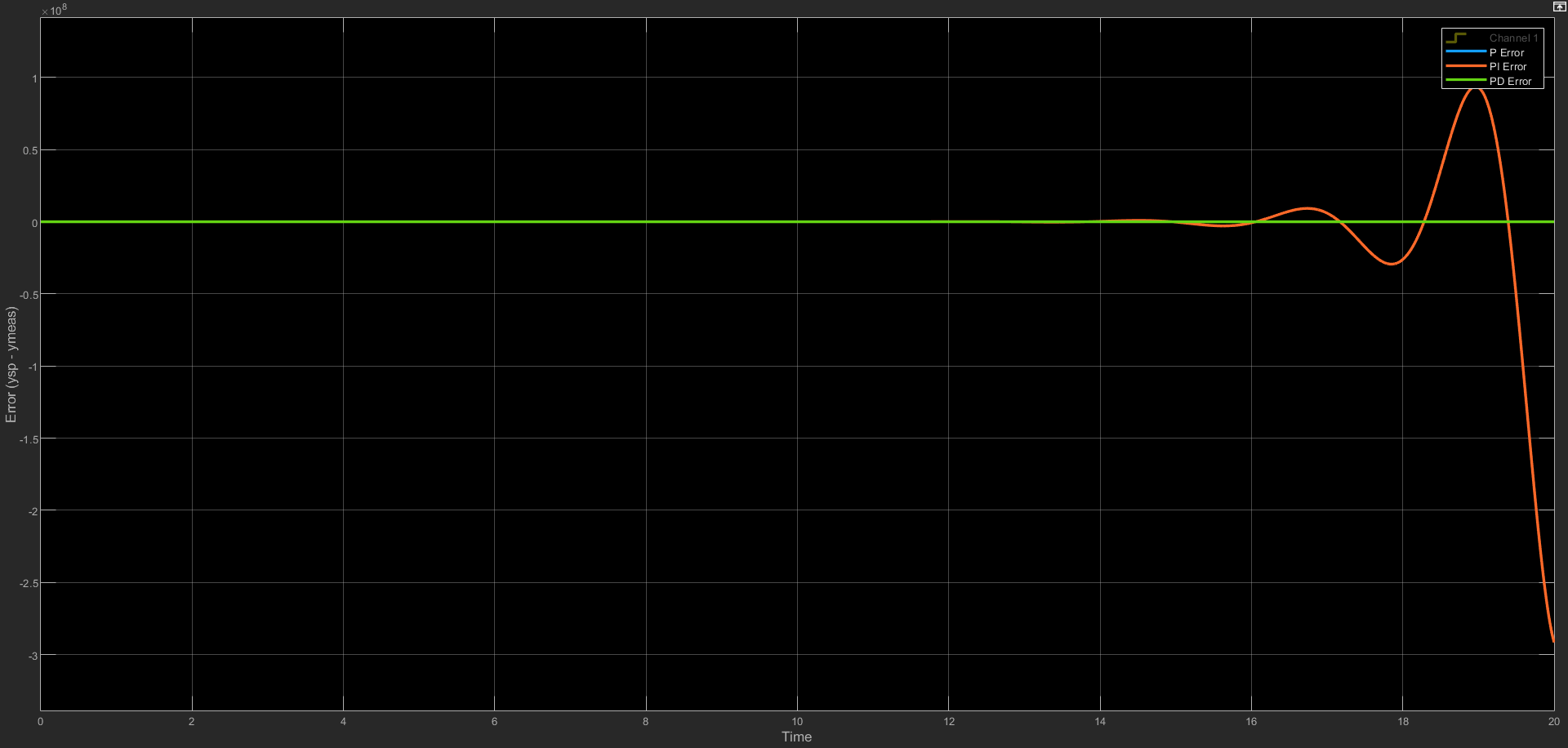
c)

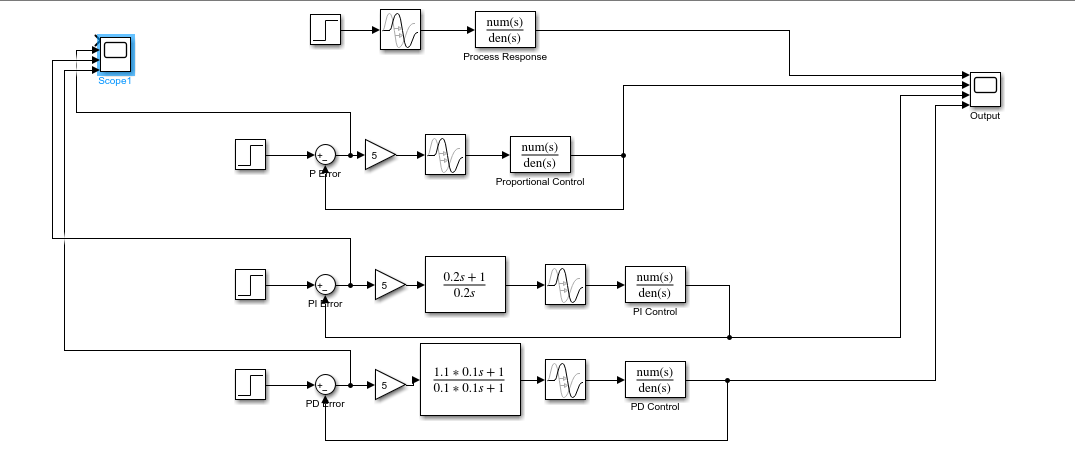
Case 1 – Underdamped (1/s^2 + s + 1)

Output

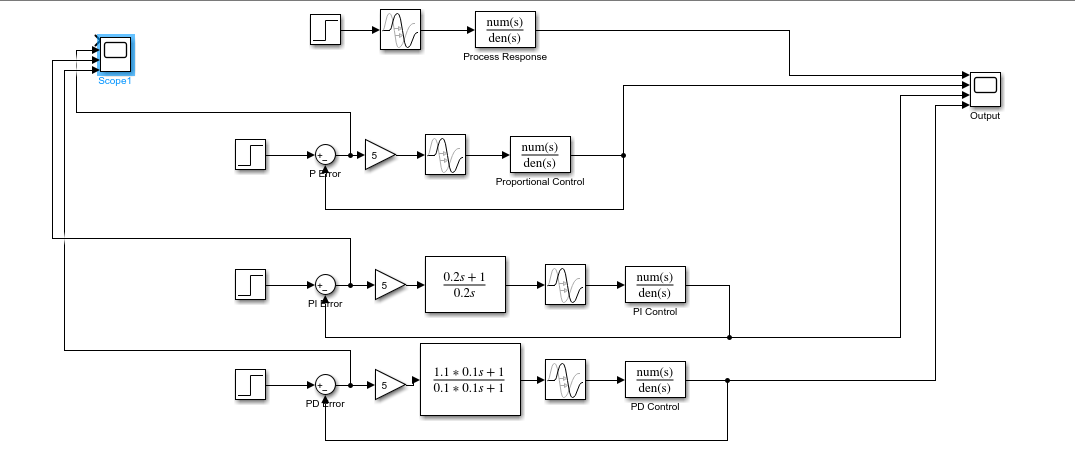


Error

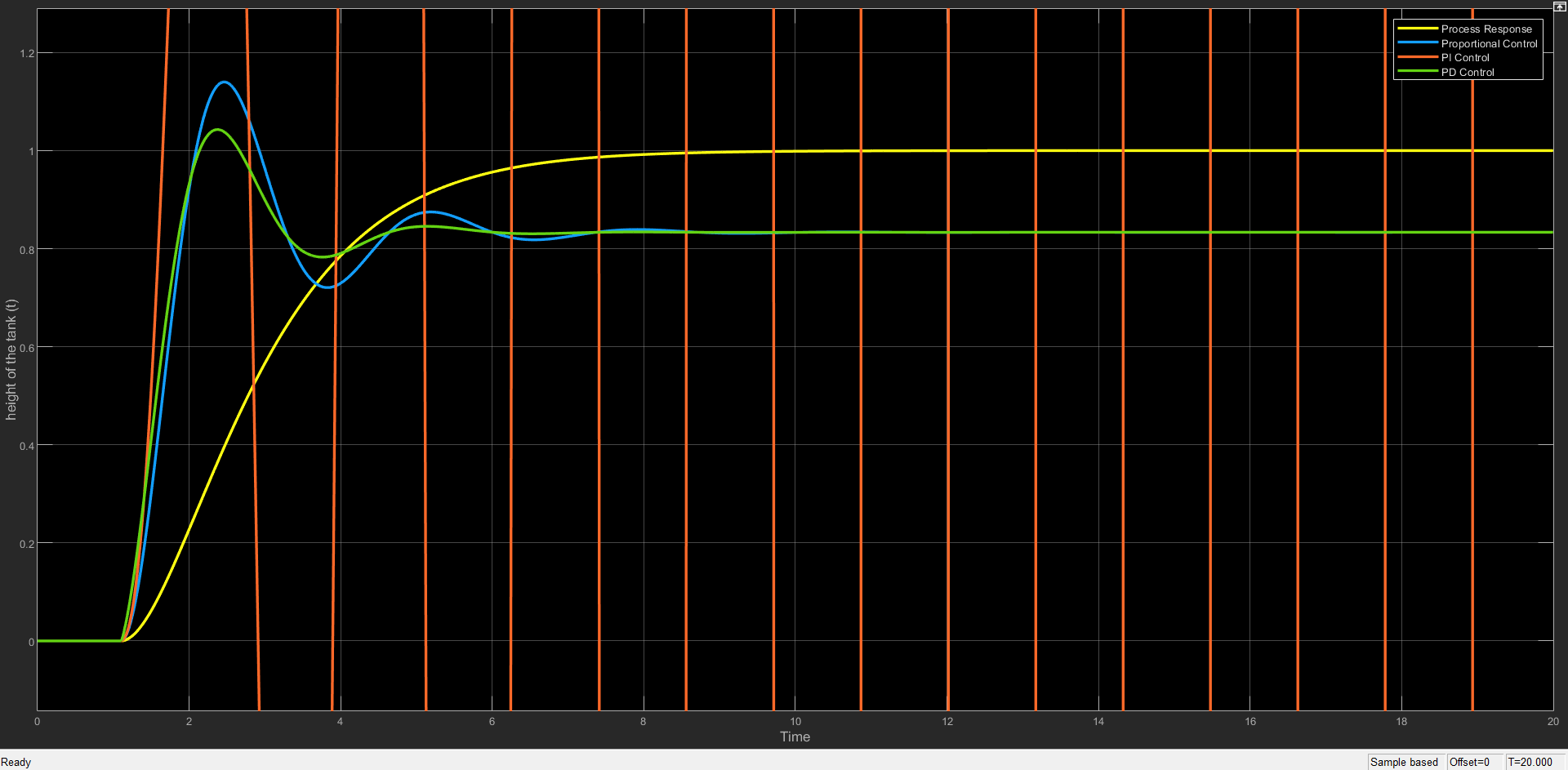




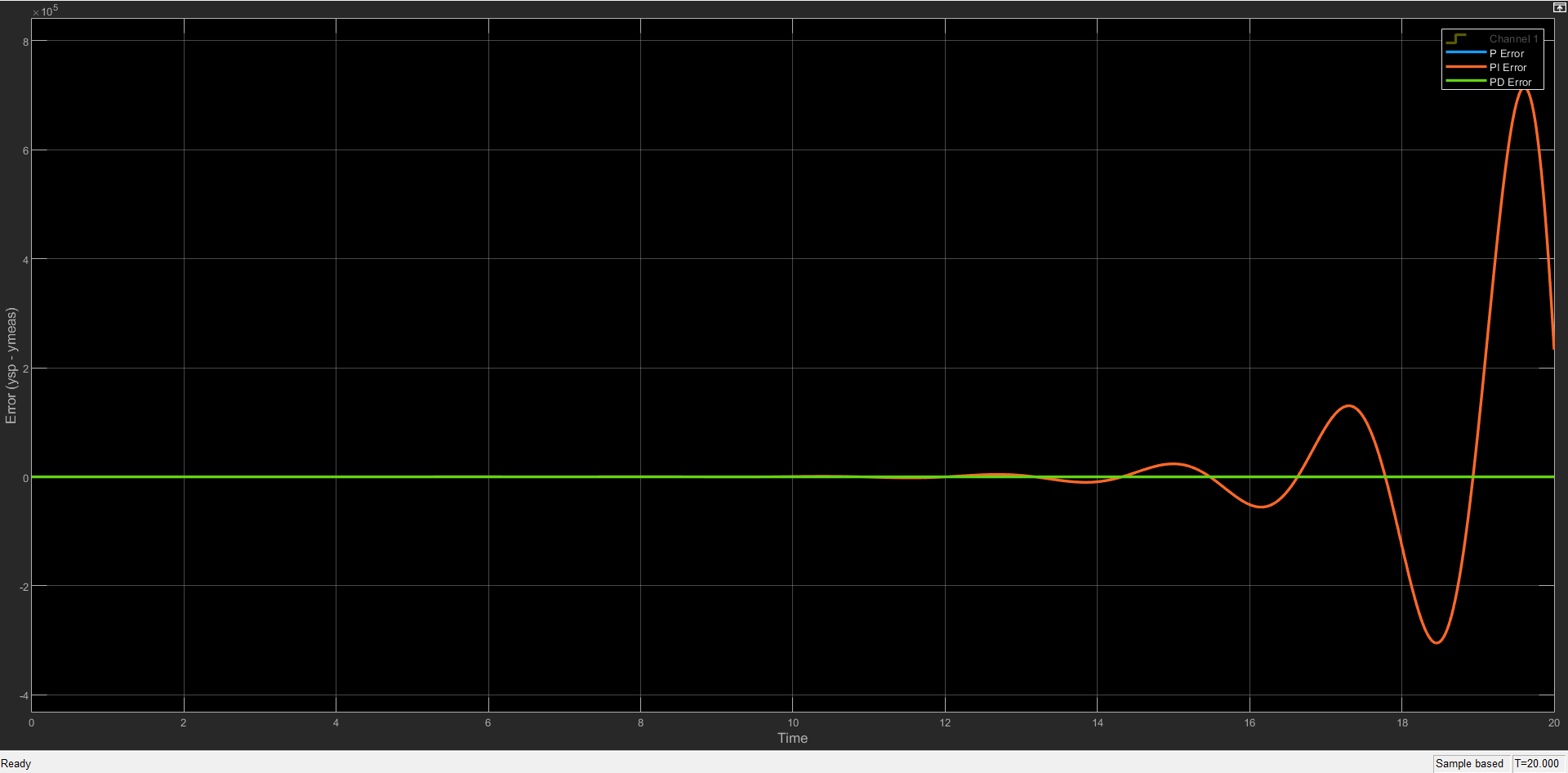
Case 2 : Critically damped (1/(s+1)^2)



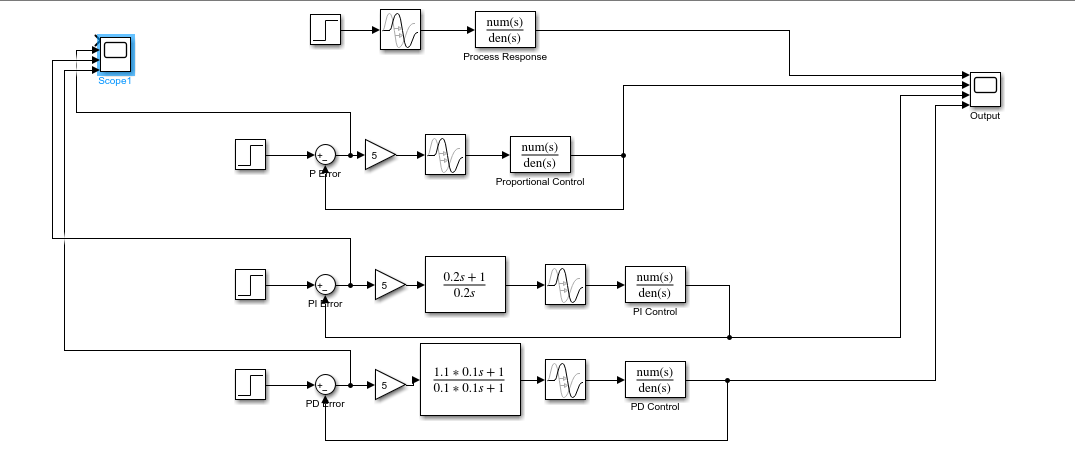
Output

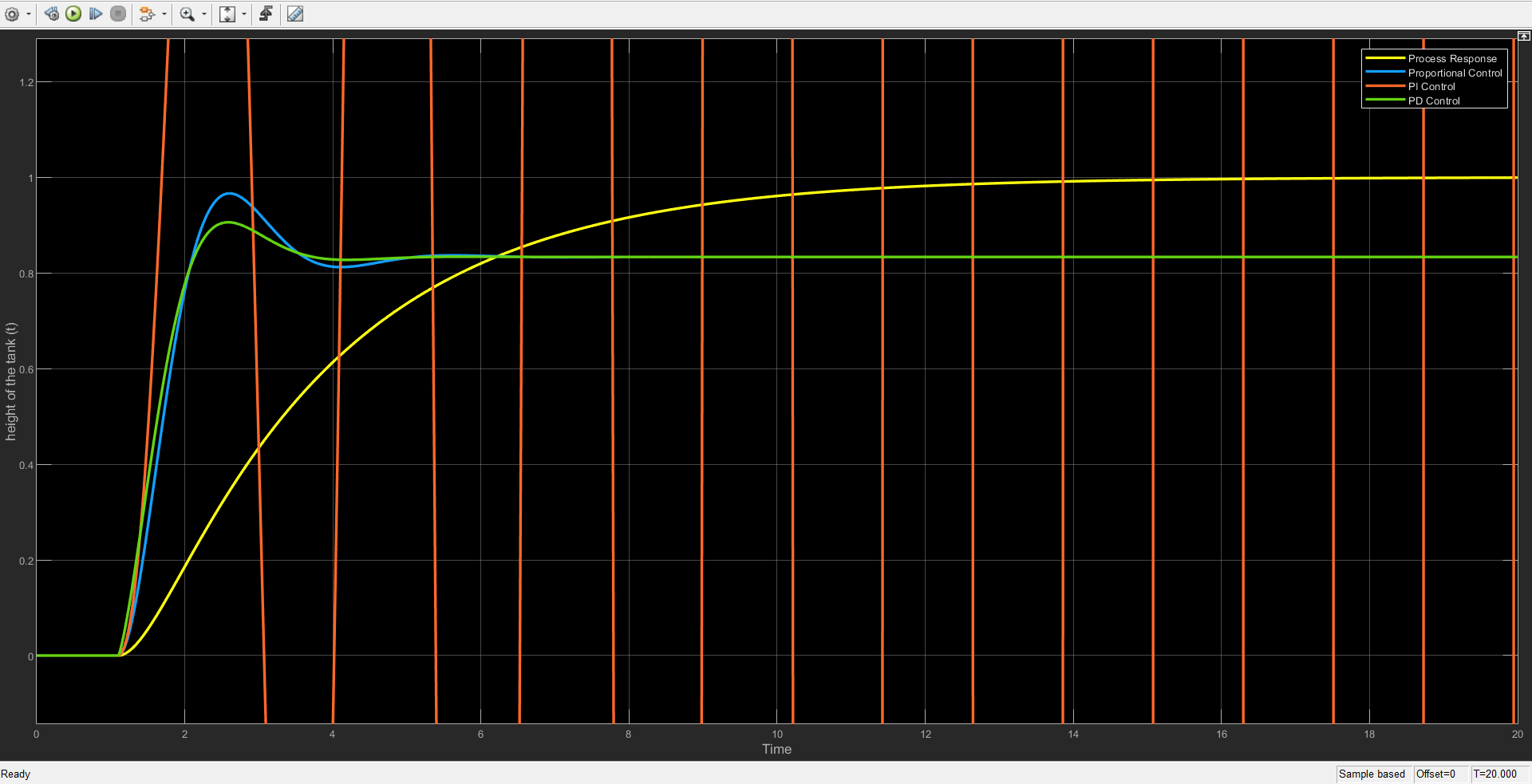


Error

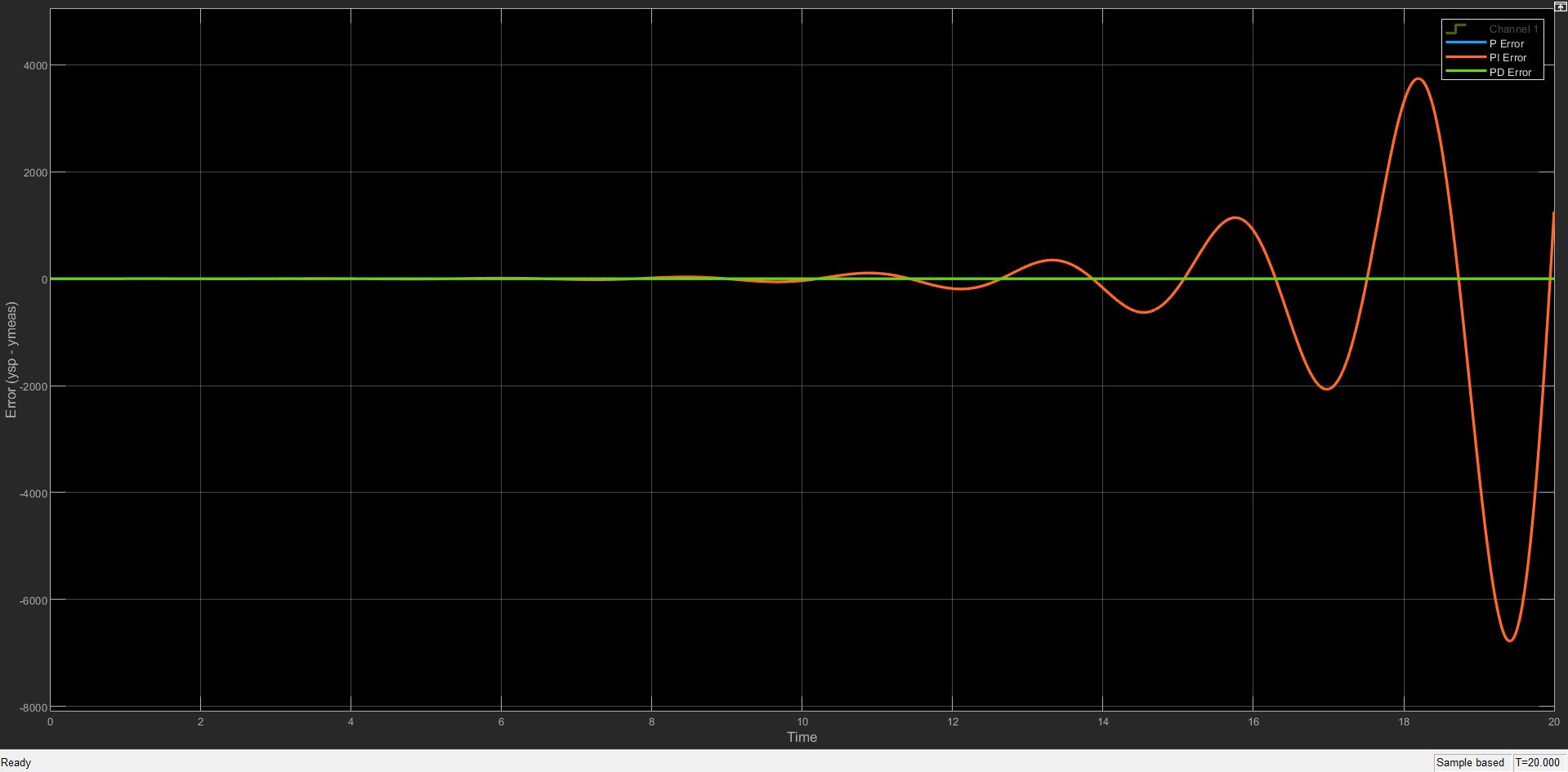


Case 3 : Over Damped (1/(s+1)(s+2))



Output 

Error



f) Yes, For underdamped systems, the Kc = 500 is also stable for the transfer function of 1/(s^2+100s+1) but for 1/s^2+10s+1, the response became unstable

