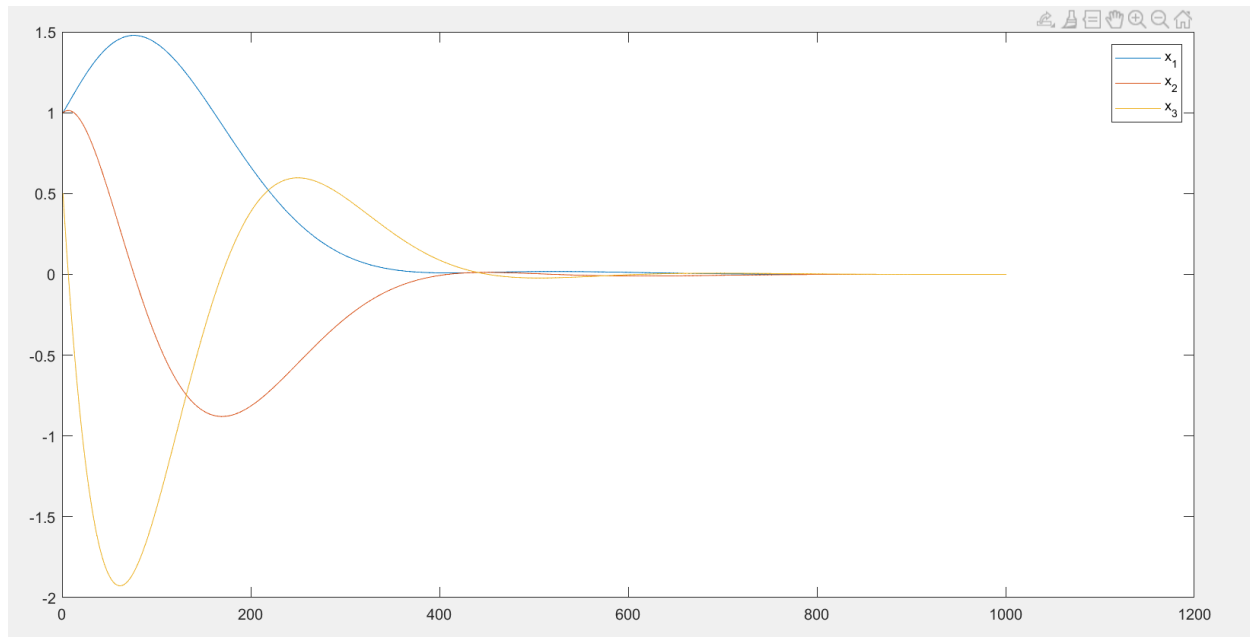


Question 3:



Question 4:

Maximum initialization is $|\theta| < \pi/2$

The values used for tuning are:

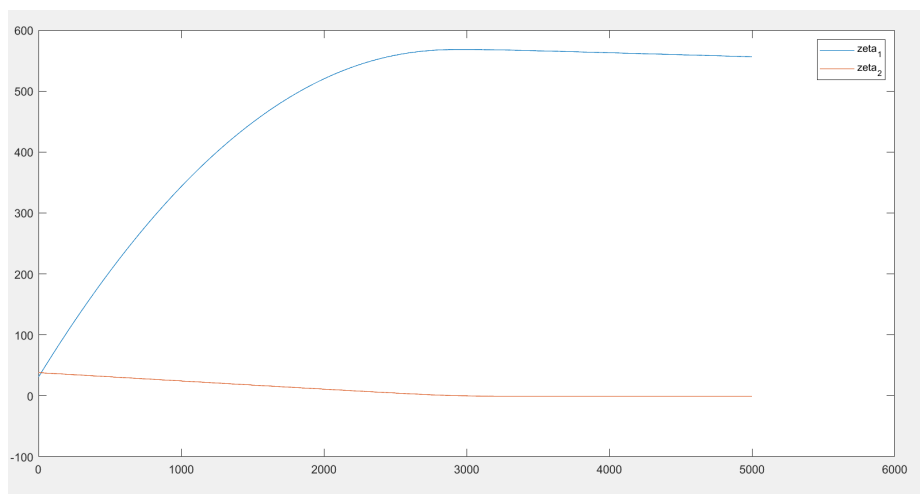
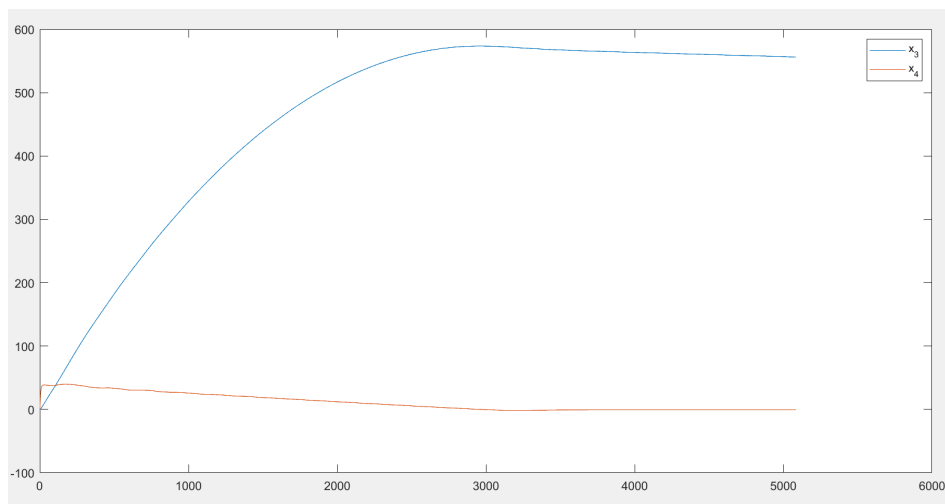
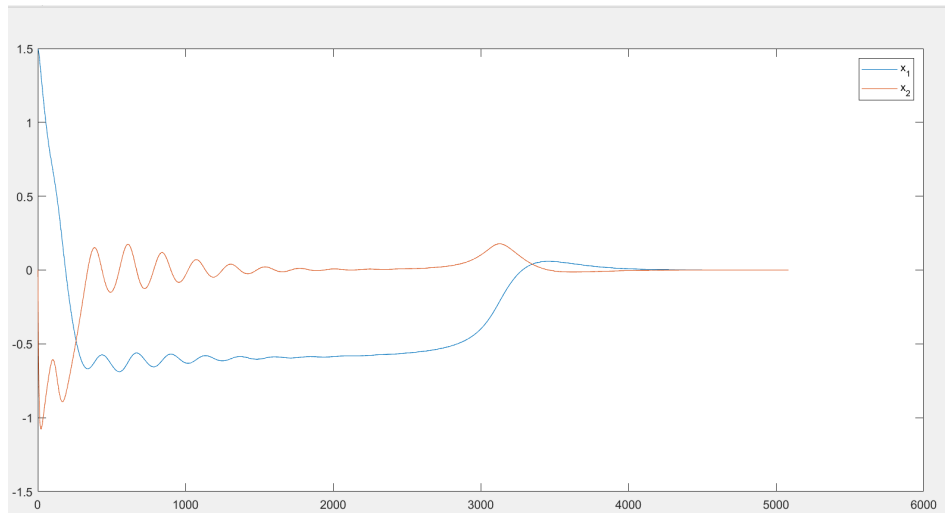
$\alpha_1 = \alpha_2 = 0.5$

$K_1 = K_2 = 1$

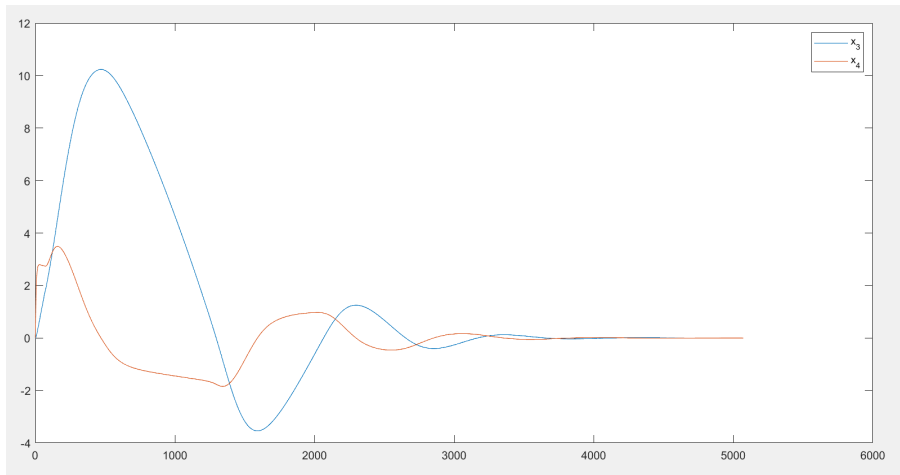
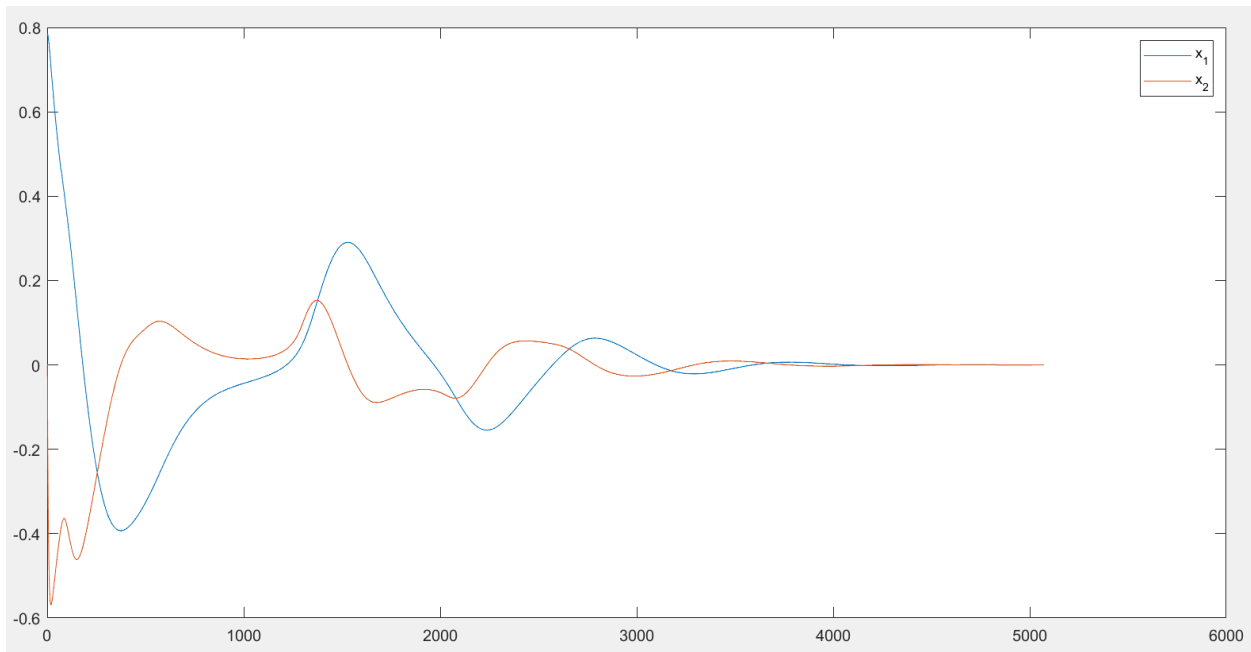
Threshold = 0.6

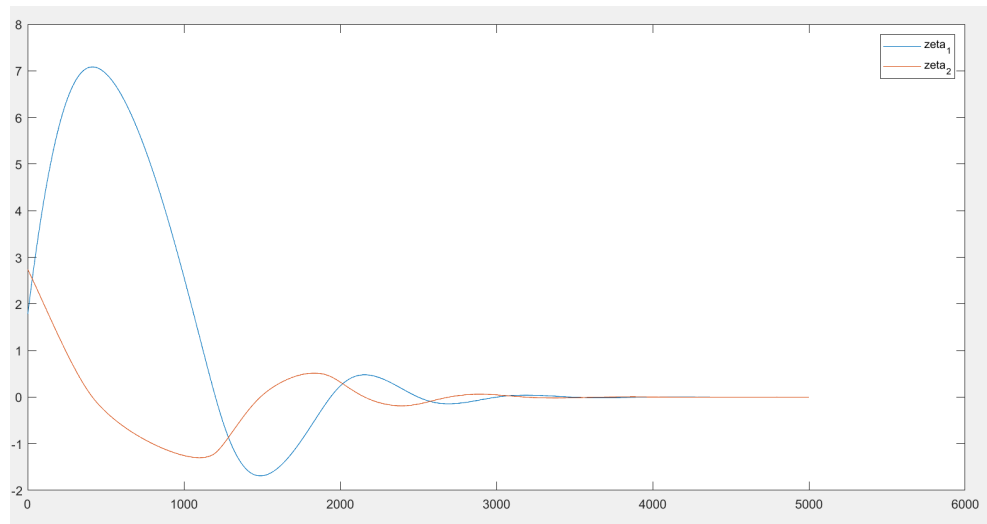
Although the gains make the system stabilize this is not a practical solution. If we see the graph of x_3 it goes to a value of almost 200. This is because to make sure that the system stabilizes before it goes to an unstable state. More practical bound can be determined when there are limitations of system actuation capacity. And the controller doesn't try to

Below is tested value for $\pi/2.1$:

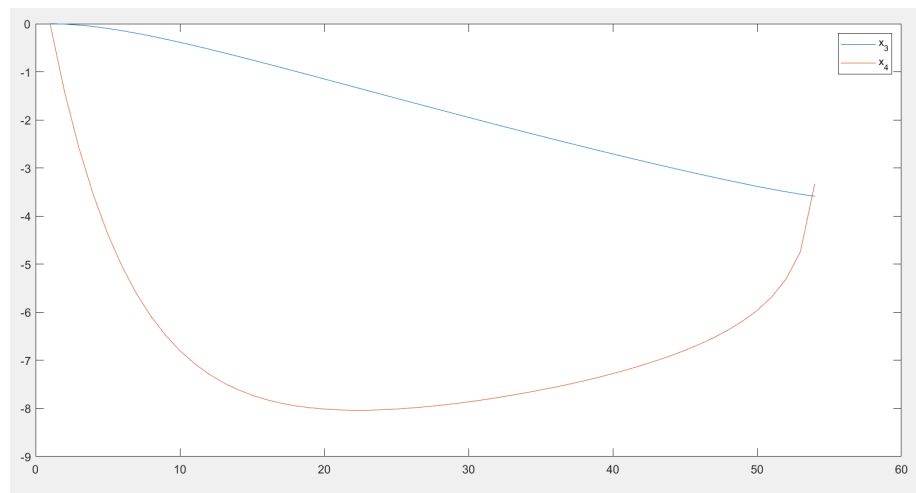
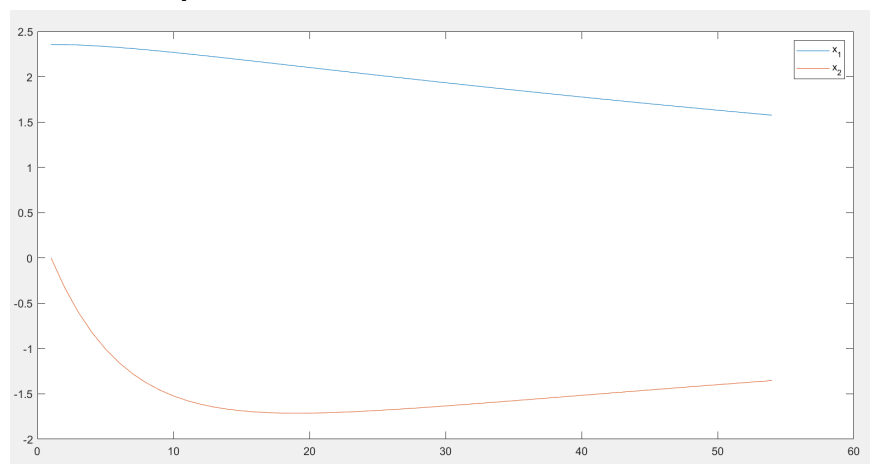


Case: $\pi/4$:





Fail Case: $3\pi/4$

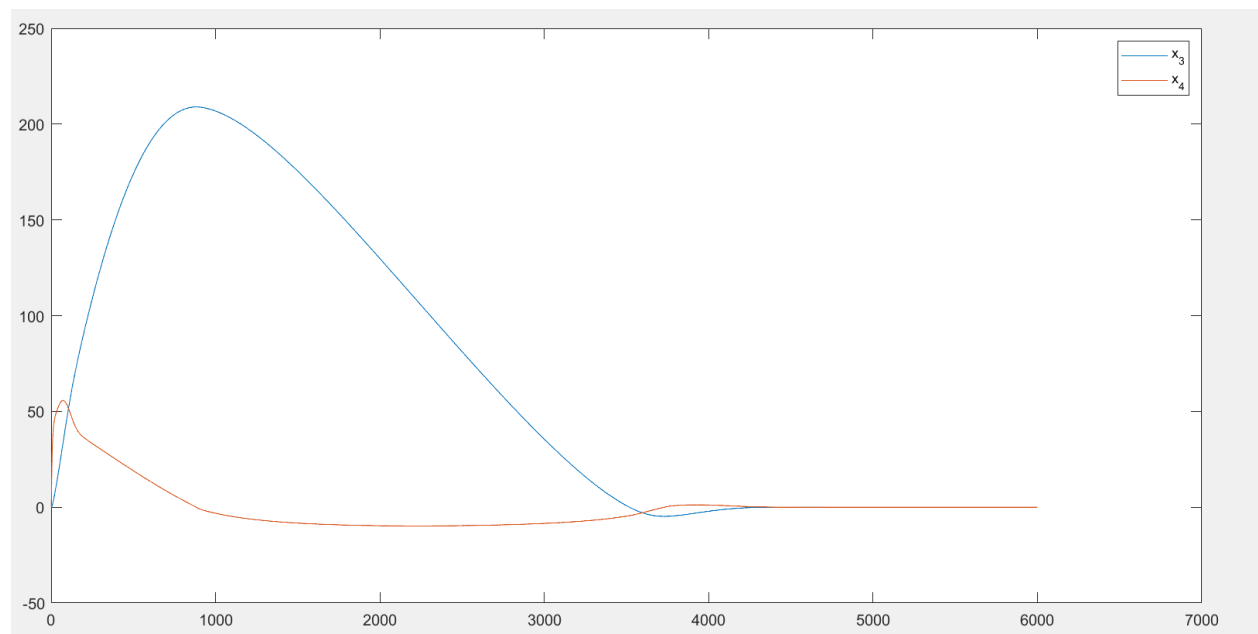
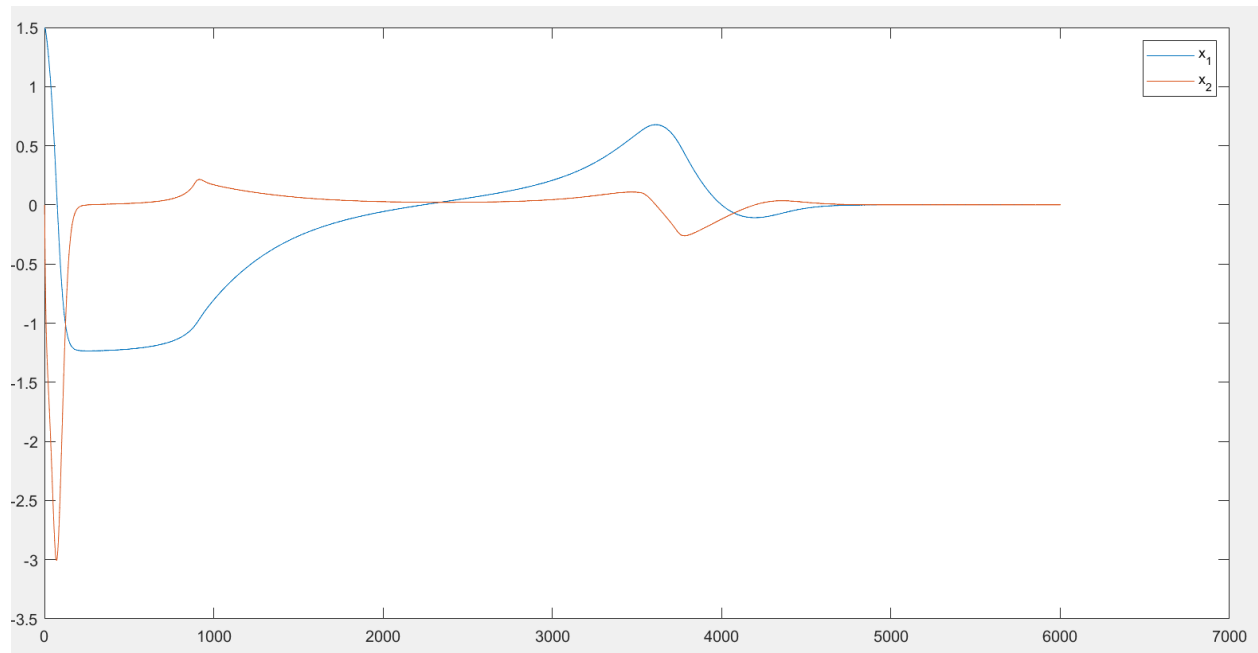


Question 5:

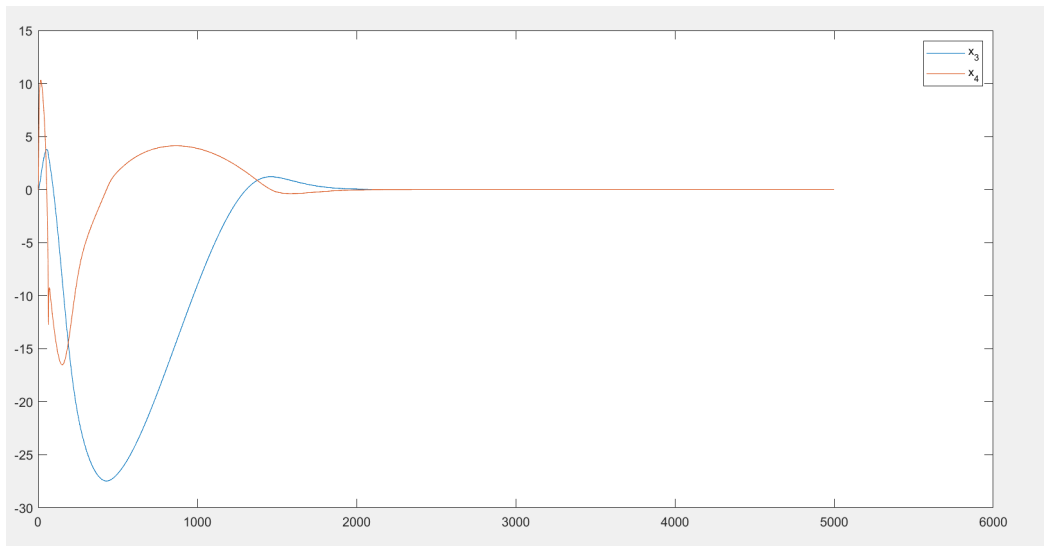
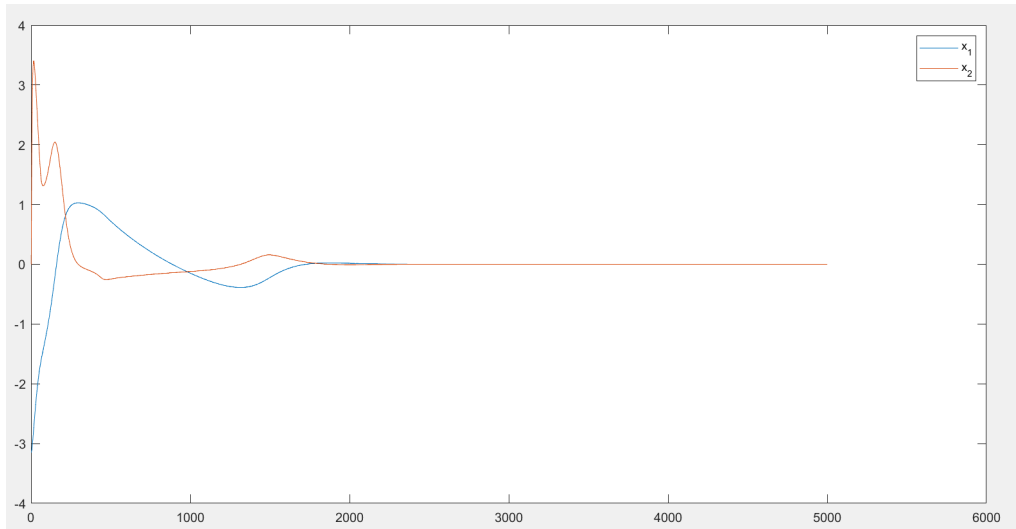
The maximum value is $|\theta| < \pi/2$ and $|\theta| > \pi/2$

Gains used are: $K_1, K_2 = [0.05; 0.1]$;

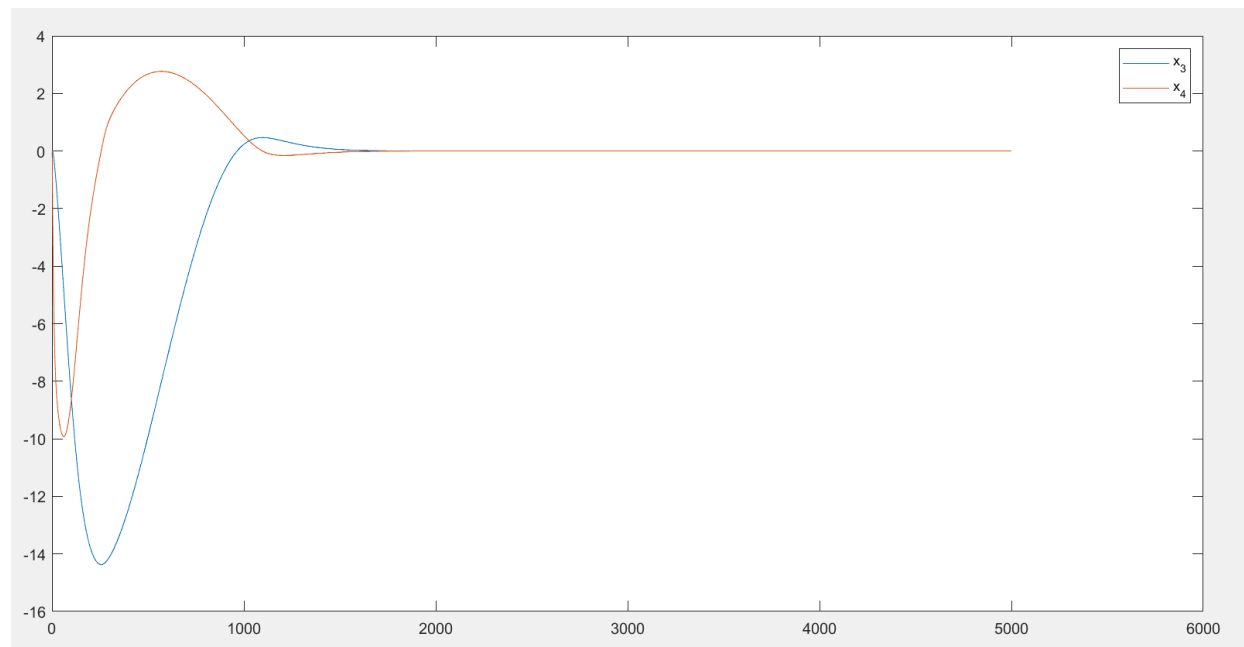
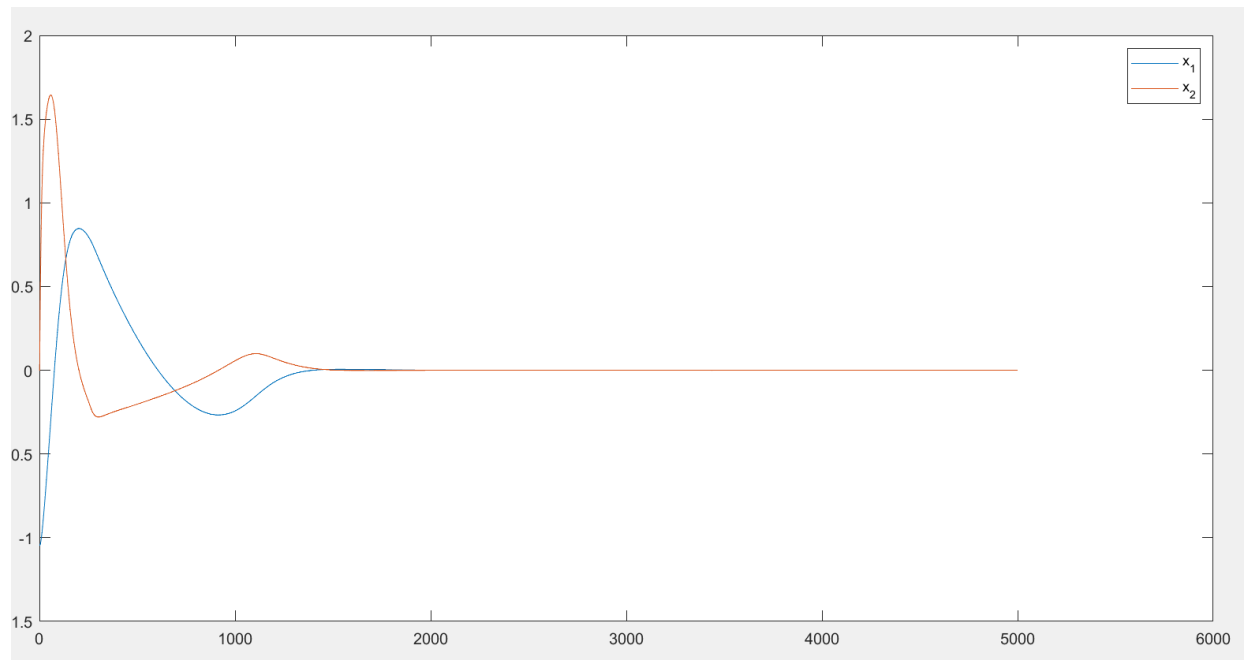
The below shows the simulation of **$\pi/2.1$**



Simulation for pi:



Case $\pi/3$:



Fail case: Simulation for $\pi/2$:

