

**2<sup>nd</sup> part****1<sup>st</sup> Question**

**First** – Observable (rank = 8); Detectable

Observable:  $|1+1j|2+3j|1+1j|0+0j|0-0j|0+0j|1-1j|1-1j$

**Second** – Non-Observable (rank = 4); Non-detectable

Observable:  $|2+3j|0+0j|0+0j|1-1j$

Non-Observable:  $|-1-1j|-1-1j|0+0j|1-1j$

**Third** – Non-Observable (rank = 4); Non detectable

Observable:  $|2+3j|0+0j|0+0j|1-1j$

Non-Observable:  $|1+1j|1+1j|0-0j|1-1j$

**Fourth** – Observable (rank=8); Detectable

Observable:  $|1+1j|2+3j|-1-1j|-2-2j|0+0j|0+0j|1-1j|1-1j$

**Fifth** – Non-Observable (rank = 4); Non detectable

Observable:  $|2+3j|-2-2j|0+0j|1-1j$

Non-Observable:  $|-1-1j|-1-1j|0+0j|1-1j$

**Sixth** – Non-Observable (rank = 4); Non detectable

Observable:  $|2+3j|-2-2j|0+0j|1-1j$

Non-Observable:  $|1+1j|-1-1j|0+0j|1-1j$

**Seventh** – Observable (rank = 8); Detectable

Observable:  $|1+1j|2+3j|1+1j|0+0j|0-0j|0+0j|1-1j|1-1j$

**Eight** – Non-Observable (rank = 4); Non detectable

Observable:  $|2+3j|2+2j|0+0j|1-1j$

Non-Observable:  $|-1-1j|-1-1j|0+0j|1-1j$

**Ninth** – Non-Observable (rank = 4); Non detectable

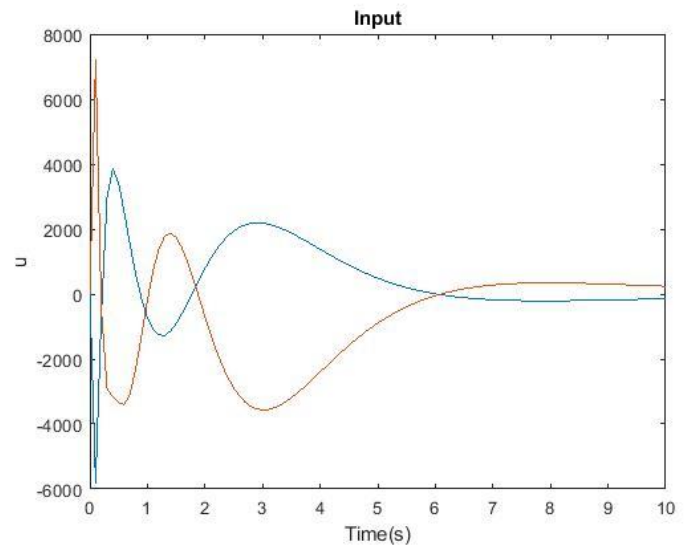
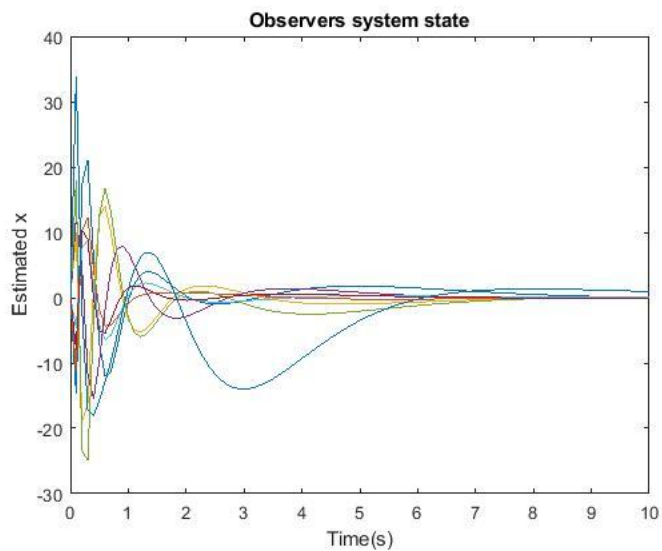
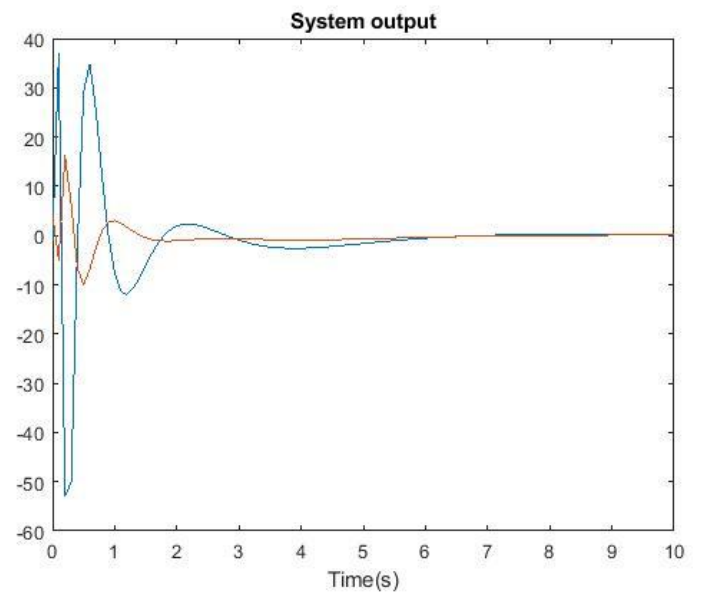
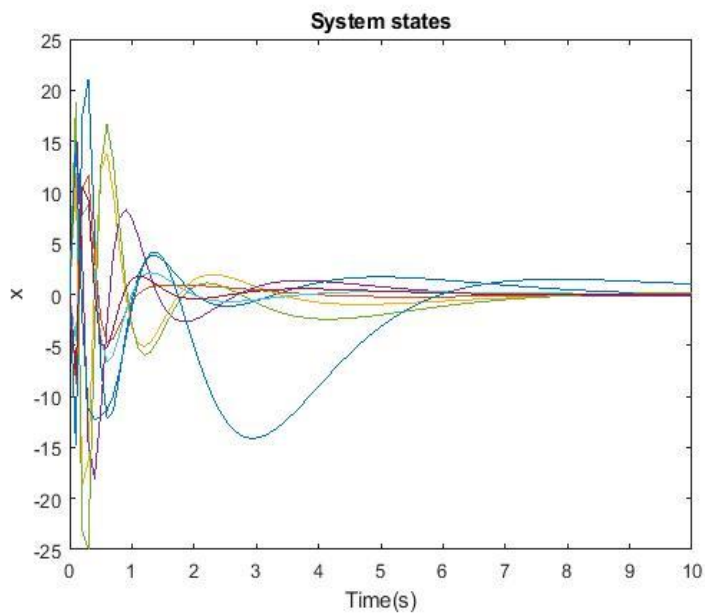
Observable:  $|2+3j|0+0j|0+0j|1-1j|1+1j|1+1j|0-0j|1-1j\sim$

## 2<sup>nd</sup> Question:

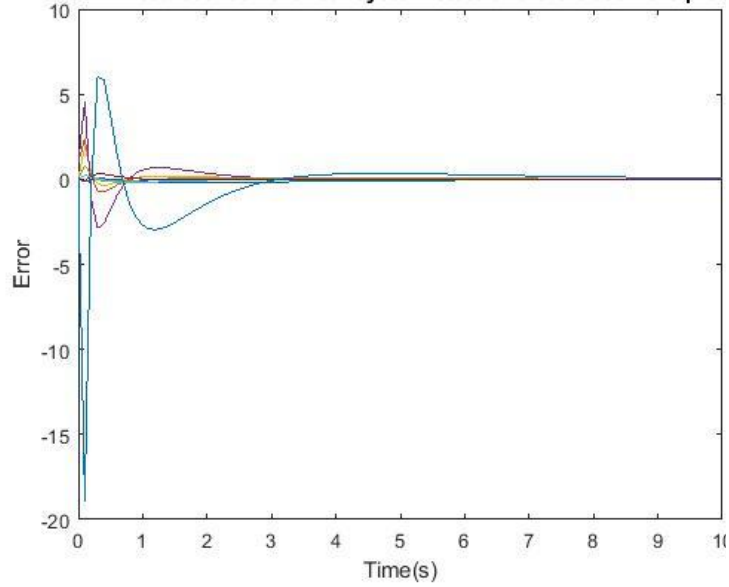
If we have non-detectable eigenvalues they will remain the same. So, if we apply randomly selected L matrices, it's possible to see that non-detectable eigenvalues remain the same.

## 4<sup>th</sup> Question:

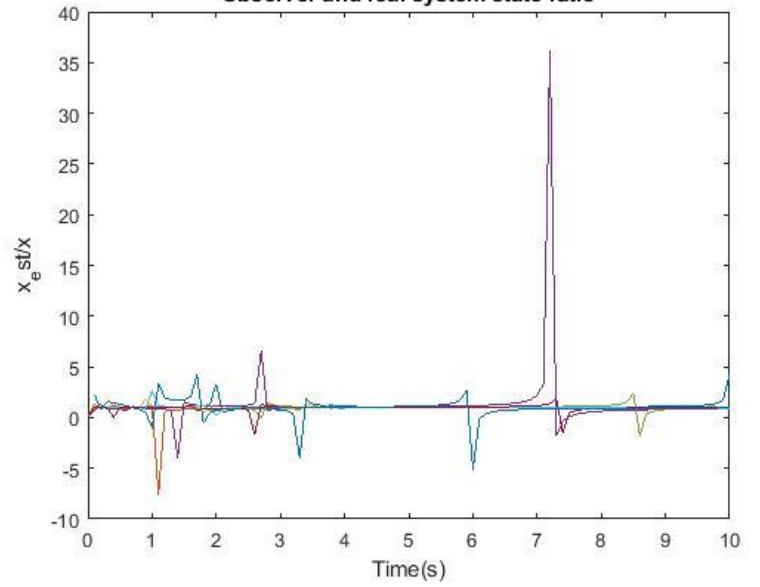
System must be observable so that the state is inferable from the output/input measurements and needs to be stabilizable so that stability is achieved. A good example of that is system 1.



Error committed between the real system state and the observers prediction



Observer and real system state ratio



### 5<sup>th</sup> Question:

$A+BF$  and  $A-LC$  are the poles of the closed loop system. These matrices include the observer, so changing its poles is equivalent to change the poles of these 2 matrices.