Table of Contents

Problem 3/CME 4.4

```
A=[0 1 0 0; 0 0 1 0; 0 0 0 1; -680 -176 -86 -6];
B=[0;0;0;1];
C=[100 20 10 0];
D=0;

sys=ss(A,B,C,D);
P=ctrb(sys);

Q=obsv(sys);
y=rank(Q);
if y==length(a)
    disp('Observable');
else
    disp('Not Observable');
end

%Previous work to find CCF
Pc1=[176 86 6 1; 86 6 1 0; 6 1 0 0; 1 0 0 0];
T=P*Pc1;
T1=inv(T);
Ac1=T1*A;
Ac=Ac1*T
Bc=T1*B
Cc=C*T
Dc=D

%Determining OCF. Comparing the two they are transpose of each other
Ao=Ac.'
Bo=Bc.'
Co=Cc.'
Do=Dc.'
```

```
Not Observable

Ac =

     0     1     0     0
     0     0     1     0
     0     0     0     1
  -680  -176   -86    -6


Bc =
```

```
     0
     0
     0
     1


Cc =

   100    20    10     0


Dc =

     0


Ao =

     0     0     0  -680
     1     0     0  -176
     0     1     0   -86
     0     0     1    -6


Bo =

     0     0     0     1


Co =

   100
    20
    10
     0


Do =

     0
```

Problem 4

```
A=[-5 -5 4; 2 0 -2; 0 -2 -1];
B=[-1; 2; -2];
C=[-1 1 2];
D=0;

sys=ss(A,B,C,D);
Q=obsv(sys);
y=rank(Q);
```

```
if y==length(a)
    disp('Observable');
else
    disp('Not Observable');
end

[num,den]=ss2tf(A,B,C,D)

syms s
frac=(-(s^2)+5*s-18)/(s^3+6*s^2+11*s+6)
frac1=simplifyFraction(frac)

if frac1==frac
    disp('Minimal form')
else
    disp('non-minimal')
end
```

```
Observable

num =

         0   -1.0000    5.0000  -18.0000


den =

    1.0000    6.0000   11.0000    6.0000


frac =

-(s^2 - 5*s + 18)/(s^3 + 6*s^2 + 11*s + 6)


frac1 =

-(s^2 - 5*s + 18)/(s^3 + 6*s^2 + 11*s + 6)

Minimal form
```

Problem 5/CME 5.4

```
A=[0 1 0 0; 0 0 1 0; 0 0 0 1; -680 -176 -86 -6];
B=[0;0;0;1];
C=[100 20 10 0];
D=0;

[num,den]=ss2tf(A,B,C,D)

frac=(10*s^2+20*s+100)/(s^4+6*s^3+86*s^2+176*s+680)

%This is the minimal form of transfer function
```

```
frac1=simplifyFraction(frac)

%displays if minimal or not
if frac1==frac
    disp('Minimal form')
else
    disp('non-minimal')
end


num1=[0 0 10]
den1=[1 4 68]

%minimal form state-space realization
[A,B,C,D]=tf2ss(num1,den1)
```

```
num =

         0         0   10.0000   20.0000  100.0000


den =

    1.0000    6.0000   86.0000  176.0000  680.0000


frac =

(10*s^2 + 20*s + 100)/(s^4 + 6*s^3 + 86*s^2 + 176*s + 680)


frac1 =

10/(s^2 + 4*s + 68)

non-minimal

num1 =

     0     0    10


den1 =

     1     4    68


A =

    -4   -68
     1     0
```

```
B =

     1
     0


C =

     0    10


D =

     0
```

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