```
a=[0 3.1;0 -5.27]
a =
```

$$A = \begin{bmatrix} 0 & 3.1000 \\ 0 & -5.2700 \end{bmatrix}$$

```
b=[0;68.0164]
b =
```

$$B = \begin{bmatrix} 0 \\ 68.0164 \end{bmatrix}$$

```
c=[1 0]
c =
```

$$C = \begin{bmatrix} 1 & 0 \end{bmatrix}$$

```
ao=a'
ao =
```

$$A_o = \begin{bmatrix} 0 & 0 \\ 3.1000 & -5.2700 \end{bmatrix}$$

```
bo=c'
bo =
```

$$B_o = \begin{bmatrix} 1 \\ 0 \end{bmatrix}$$

```
O=[bo ao*bo]
O =
```

$$O = \begin{bmatrix} 1.0000 & 0 \\ 0 & 3.1000 \end{bmatrix}$$

```
rank(O)
ans =
```

2 ← Completely observable

```
poly(a)
ans =     Char. poly of A
```

$$\begin{bmatrix} 1.0000 & 5.2700 & 0 \end{bmatrix}$$

```
poly(ao)
ans =     Same as char poly of A^T
```

$$\begin{bmatrix} 1.0000 & 5.2700 & 0 \end{bmatrix}$$

```
Apvo=[0 1;0 -5.27]
Apvo =
```

$$A_{PV_o} = \begin{bmatrix} 0 & 1.0000 \\ 0 & -5.2700 \end{bmatrix}$$

```
Bpvo=[0;1]
Bpvo =
```

$$B_{PV_o} = \begin{bmatrix} 0 \\ 1 \end{bmatrix}$$

```
Mpvo=[Bpvo Apvo*Bpvo]
Mpvo =
```

$$M_{A_{V_o}} = \begin{bmatrix} 0 & 1.0000 \\ 1.0000 & -5.2700 \end{bmatrix}$$

```
Tpvo=O*inv(Mpvo)
Tpvo =
```

$$T_{PV_o} = \begin{bmatrix} 5.2700 & 1.0000 \\ 3.1000 & 0 \end{bmatrix}$$

```
Kot=[1640+0 81-5.27]*inv(Tpvo)
Kot =
```

$$K_o^T = \begin{bmatrix} 75.7300 & 400.2913 \end{bmatrix}$$

```
Ko=Kot'
Ko =
```

$$\begin{bmatrix} 75.7300 \\ 400.2913 \end{bmatrix} = K_o$$ (1a)

```
eig(a-Ko*c)
ans =
   -41.0000
   -40.0000

vref=4;
Nu=[0];
Nx=[1;0];
k=[1.8923 0.5106];
eo=[0;0];
t=[0:.005:1];
e=lsim(a-Ko*c,b,eye(2),[0;0],zeros(1,length(t)),t,e0);
[y,x]=lsim(a-b*k,b,c,[0],(Nu+k*Nx)*vref*ones(1,length(
t))-k*e',t);
plot(t,x,t,x+e);grid
title('EE571 - Pre-Lab 4 Simulation of
Observer/Controller with e(0)=[0;0]')
xlabel('time (sec)');ylabel('x and xhat (volts)')
meta lab4a
e0=[2;-1];
e=lsim(a-Ko*c,b,eye(2),[0;0],zeros(1,length(t)),t,e0);
[y,x]=lsim(a-b*k,b,c,[0],(Nu+k*Nx)*vref*ones(1,length(
t))-k*e',t);
plot(t,x,t,x+e);grid
xlabel('time (sec)');ylabel('x and xhat (volts)')
title('EE571 - Pre-Lab 4 Simulation of
Observer/Controller with e(0)=[2;-1]')
meta lab4b
c
c =
     1     0

r=[0 1]
r =
```

$$\begin{bmatrix} 0 & 1 \end{bmatrix} = R$$

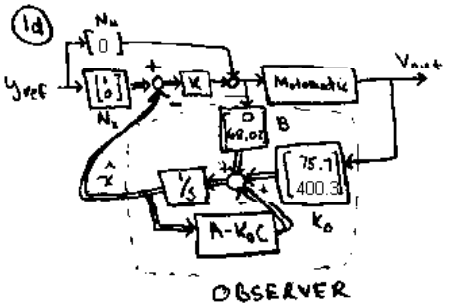
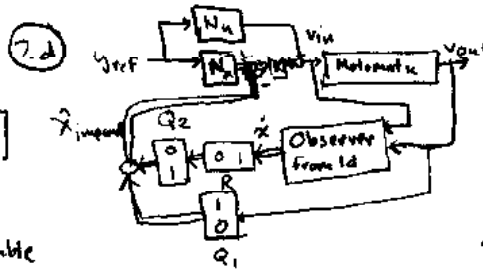
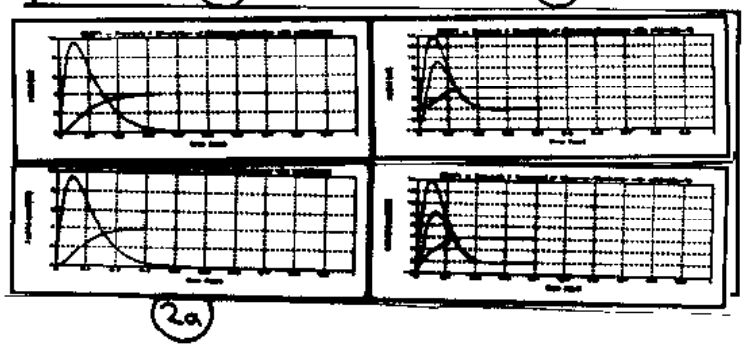
```
inv([c;r])
ans =
```

$$\begin{bmatrix} 1 & 0 \\ 0 & 1 \end{bmatrix} = \begin{bmatrix} C \\ R \end{bmatrix}^{-1}$$

```
q1=[1;0]
q1 =
```

$$\begin{bmatrix} 1 \\ 0 \end{bmatrix} = Q_1$$

```
q2=[0;1]
q2 =
```

$$\begin{bmatrix} 0 \\ 1 \end{bmatrix} = Q_2$$

```
e0=[0;0];e=lsim(a-Ko*c,b,eye(2),[0;0],zeros(1,length(t
)),t,e0);
[y,x]=lsim(a-b*k,b,c,[0],(Nu+k*Nx)*vref*ones(1,length(
t))-k*q2*r*e',t);
plot(t,x,t,(q1*c+q2*r)*x'+q2*r*e');grid
title('EE571 - Pre-Lab 4 Improved of
Observer/Controller with e(0)=[0;0]')
xlabel('time (sec)');ylabel('x and xhat_improved
(volts)')
meta lab4c
e0=[2;-1];e=lsim(a-Ko*c,b,eye(2),[0;0],zeros(1,length(
t)),t,e0);
[y,x]=lsim(a-b*k,b,c,[0],(Nu+k*Nx)*vref*ones(1,length(
t))-k*q2*r*e',t);
plot(t,x,t,(q1*c+q2*r)*x'+q2*r*e');grid
title('EE571 - Pre-Lab 4 Improved of
Observer/Controller with e(0)=[2;-1]')
xlabel('time (sec)');ylabel('x and xhat_improved
(volts)')
meta lab4d
quit
```