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```
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
% Praful Sigdel
% Exam 3
% Linear Control Theory
% December 14 2022
%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%%
```

Problem 1

```
A = [-1 1;0 2];
B = [1; 0];

% Problem 1 b
ctrb_m = ctrb(A,B);
rank(ctrb_m) % Should equal to 2 to be controllable.
```

ans =

1

Problem 2

```
A = [0 1 0; 0 0 1;-6 -11 -6];
B = [0;0;10];
C=[1 0 0];
D=0;

% problem b
ctrb_m = rank([B, A*B, A*A*B]) % This value should equal to total number of
                                % states of the system i.e. 3 to be
                                % controllable.

% problem c
K = place(A,B,[-10 -2+2*sqrt(3)*j -2-2*sqrt(3)*j])
```

ctrb_m =

3

$K =$

15.4000 4.5000 0.8000

Problem 4

```
A = [0 1 0; 0 0 1; -5 -6 0];
```

```
B = [0; 0; 1];
```

```
C = [1 0 0];
```

```
% Problem a
```

```
observ_m = [C.' A.'*C.' (A.')^2*C.'];
```

```
rank(observ_m) % This value should equal to the order of the system i.e. 3
```

```
% Problem b
```

```
% Design a full-order observer so that the observer pole lies at s =-10,
```

```
% s=-15, and s=-10.
```

```
L = acker(A.', C.',[-10 -10 -15])
```

```
%Problem C
```

```
ctrb_ma = [B, A*B, A*A*B];
```

```
rank(ctrb_ma)
```

```
%Problem D
```

```
K_fsf = place(A,B,[-2+4*j, -2-4*j, -4])
```

```
observ_m =
```

```
1      0      0
0      1      0
0      0      1
```

```
ans =
```

```
3
```

```
Warning: Pole locations are more than 10% in error.
```

```
L =
```

```
35                      394                      1285
```

```
ans =
```

```
3
```

```
K_fsf =
```

75.0000 30.0000 8.0000

Problem 7

```
A = [0 1 0;0 0 1;0 -2 -1.25];  
B = [0 0;0 0;100 -80];  
C = [1 0 0];  
D = 0;  
rank(ctrb(A,B)) % This should equal 3(order of the system) to be controllable.  
K = place(A,B,[-34 -35 -36])
```

ans =

3

K =

```
261.2195    22.3902    0.6326  
-208.9756   -17.9122   -0.5061
```

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