# NATIONAL INSTITUTE OF TECHNOLOGY SIKKIM



**CONTROL SYSTEM LABORATORY II**

NAME :- VIKRAM KUMAR

ROLL NO:- B190095EE

SUBJECT:- CONTROL SYSTEM LAB- (II)

SUBJECT CODE:-EE16203

SUBMITTED TO :- DR. KUNTAL MONDAL

SUBMITTED BY:- VIKRAM KUMAR

**EXPERIMENT -3**

**AIM:-** To design (a) gain matrix for pole placement, (b) the state observer for the following system:

0 1 0 0

A= 0 0 1 B= 0

-1-5-6 1

desired closed loop poles are s = -2±j4 and s =-10.

0 1 0 0

A= 0 0 1 B= 0 C= 1 0 0

-6-11-6 1

the desired eigenvalues of the observer matrix are -10 and -10.

**MATLAB CODE:-**

clear all

clc

close all

A=input('Enter the system matrix: ');

B=input('Enter the input matrix: ');

P=input('Enter the desired poles');

E=eig(A);

if E<0

disp('System is stable.');

else

disp('System is unstable');

end

Cm=ctrb(A,B) %controllabilty matrix

Rank=rank(Cm)

if length(A)==Rank

disp('The system is completely controllable.');

else

disp('The sytem is uncontrollable.');

end

K=acker(A,B,P) %state feedback gain matrix

A=input('Enter the system matrix: ');

C=input('Enter the output matrix: ');

P=input('Enter the desired poles: ');

E=eig(A);

if E<0

disp('System is stable.');

else

disp('System is unstable');

end

Om=obsv(A,C) %controllabilty matrix

Rank=rank(Om)

if length(A)==Rank

disp('The system is completely observable.');

else

disp('The sytem is unobservable.');

end

for i=2:length(A)

Aab(i-1)=A(1,i);

for j=2:length(A)

Abb(i-1,j-1)=A(i,j);

end

end

K=acker(Abb',Aab',P)' %state observer gain matrix

**OUTPUT:-**

Enter the system matrix: [0 1 0; 0 0 1; -1 -5 -6]

Enter the input matrix: [0; 0; 1]

Enter the desired poles[-2+4\*i -2-4\*i -10]

System is stable.

Cm =

0 0 1

0 1 -6

1 -6 31

Rank =

3

The system is completely controllable.

K =

199 55 8

Enter the system matrix: [0 1 0; 0 0 1; -6 -11 -6]

Enter the output matrix: [1 0 0]

Enter the desired poles: [-10 -10]

System is stable.

Om =

1 0 0

0 1 0

0 0 1

Rank =

3

The system is completely observable.

K =

14

5

**DISCUSSION:-**

* It is noted that for state controllable and state observable if system is unstable we have to maintain the stability of the system we have to find the system gain matrix (K) for state controllable . observer gain matrix (Ke) for state observable.
* For order 4 or higher order in the system we have to apply

Ackerman’s Formula we can easily determined system gain matrix or observer gain matrix.

* Necessary and sufficient condition for finding the gain matrix or observer gain matrix , The system is completely controllable or completely observable.