```
clc
clear
close all

% Load the parameters of the system
run('load_pendulum_params')

% Decide the weighting of each of the states
Q = zeros(4);
Q(1,1) = 6;  % Hub angle position
Q(2,2) = 1;  % Pendulum angle position
Q(3,3) = 0.1; % Hub angle velocity
Q(4,4) = 0.1; % Pendulum angle velocity
Q = Q/norm(Q); % Normalize the weight matrix

% Set the weight of the input
R = 0.5;

% Create the output matrices
C = eye(4);
D = zeros(4,1);

% Calculate the gain vector
sys = ss(Am, Bm, C, D);
[K,S,E] = lqr(sys, Q, R);
disp("Feedback gain: ")
disp(K)

%Checking controlability of the system
comat=ctrb(Am,Bm);
corank=rank(comat);

%Chekcing open loop eigenvalues:
eigA = eig(Am);
disp("Eigenvalues of Am: ");
disp(eigA);

%Closed Loop eigenvalues desired:
P=[-3 -48 -7 -5.85];

%calculating Kcl using pole placement and checking closed loop
 eignenvals
Kcl=place(Am,Bm,P);
disp("Gain: ");
disp(Kcl);
Acl= Am-Bm*Kcl;
Eigcl =eig(Acl);
disp("Eigenvalues for Acl: ");
disp(Eigcl);
```

```
Feedback gain:
   -1.4142   14.2749   -1.6108    1.9318
```

```
Eigenvalues of Am:
         0
  -48.2751
    7.0564
   -5.8579

Gain:
   -1.6209   14.2706   -1.6498    1.9247

Eigenvalues for Acl:
  -48.0000
   -7.0000
   -5.8500
   -3.0000
```

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