```
%% Set up workspace
clc
clear
close all
load('pendulum_params') % This contains the pendulum
constants and linearized matrices

%% Set up Matrices

% Unknown electrical parameters of the motor
syms kt km Rm real
Kg = 70;     % gear ratio of the motor
motor_dyn = Kg^2*kt*km/Rm;

% Generate the modified A and B matrices
detMinv = 1/det(M);
Am = sym(linsys.A);
Am(3,3) = linsys.A(3,3) - (motor_dyn
*(Jp+0.25*mp*Lp^2))*detMinv;
Am(4,3) = linsys.A(4,3) - 0.5*detMinv*motor_dyn*mp*Lp*Lr;

Bm = Kg*kt/Rm * linsys.B;

%% Calculate the observability matrix
C = [1 0 0 0 ;
     0 1 0 0];
obs_mat = [C;C*Am;C*Am^2;C*Am^3];
fprintf("Observability matrix is of rank %d\n",
rank(obs_mat));
if rank(obs_mat) == 4
    disp("The system is observable")
else
    disp("The system is not observable")
end
disp(" ")

%% Place the poles of the gain matrix

% Place all the poles
pp = [-2;-3;-2;-3];
L = place(linsys.A', C', pp);
fprintf("Pole placements for eigenvalues of (%.1f, %.1f,
%.1f, %.1f):\n", pp);
disp(L)
```