MECA 482 Project

```
clc
clear
% State Space Representation
Jp=.8;Mp=.127;Lr=.216;Jr=.8;Lp=.337;g=9.81;Br=37.3;Bp=2;Kg=.9;kt=0.00768;km=.03;..
    Rm=2.6;Mr=.125; %Random Parameters
Jt=Jp*Mp*Lr^2+Jr*Jp+(1/4)*Jr*Mp*Lp^2;
A=[0 0 1 0;0 0 0 1;0 (1/(4*Jt))*Mp^2*Lp^2*Lr*g (-1/Jt)*Br*(Jp
+1/4*Mp*Lp^2) (-1/(2*Jt))*Bp*Mp*Lp*Lr;0 .5*Mp*Lp*g*(Jr+Mp*Lr^2)/Jt (1/
(2*Jt))*Mp*Lp*Lr*Br (-1/Jt)*Bp*(Jr+Mp*Lp^2)];
B=[0;0;(1/Jt)*(Jp+.25*Mp*Lp^2);(1/(2*Jt))*Mp*Lp*Lr];
C=eye(2,4);
D=zeros(2,1);
% Actuator Dynamics
B=Kg*kt*B/Rm;
A(3,3)=A(3,3)-Kg^2*kt*km/Rm*B(3);
A(4,3)=A(4,4)-Kg^2*kt*km/Rm*B(4);
states={'theta' 'theta_dot' 'alpha' 'alpha_dot'};
inputs={'u'};
outputs={'theta';'alpha'};

sys_Pendulum =
 ss(A,B,C,D,'statename',states,'inputname',inputs,'outputname',outputs) %
 Open loop system model
sys_tf=tf(sys_Pendulum) % System transfer function

% The requirements of the system
zeta = 0.7;
wn = 4;
p3 = -30; % Desired pole location
p4 = -40; % Desired pole location
% Location of dominant poles along real-axis
sigma = zeta * wn;
% Location of dominant poles along img axis (damped natural freq
 wn*(1-zeta)^0.5)
wd=wn*(1-zeta)^0.5
% Desired poles (-30 and -40 are given)
poles = [-sigma+j*wd, -sigma-j*wd, p3, p4];
% Find control gain using MATLAB pole-placement command (acker or
 place)
K = acker(A, B, poles)
mu=2.3;
Ep=Mp*g*Lp; %Potential Energy
Er=Ep;
eta_m=0.90;
eta_g=0.70;
K_amp=2.5 ;  %Amplifier gain


sys_Pendulum =
```

```
  A =
                 theta  theta_dot      alpha  alpha_dot
   theta             0          0          1          0
   theta_dot         0          0          0          1
   alpha             0   0.001498     -46.28   -0.01427
   alpha_dot         0     0.2612     -2.515     -2.515

  B =
                    u
   theta            0
   theta_dot        0
   alpha       0.003299
   alpha_dot  1.897e-05

  C =
              theta  theta_dot      alpha  alpha_dot
   theta          1          0          0          0
   alpha          0          1          0          0

  D =
          u
   theta  0
   alpha  0

Continuous-time state-space model.


sys_tf =

  From input "u" to output...
           0.003299 s^2 + 0.008296 s - 0.0008617
   theta:  -----------------------------------
           s^4 + 48.8 s^3 + 116.1 s^2 - 12.09 s

                1.897e-05 s - 0.007419
   alpha:  -------------------------------
           s^3 + 48.8 s^2 + 116.1 s - 12.09

Continuous-time transfer function.


wd =

    2.1909


K =

   1.0e+07 *

   -1.7601   -2.0718    0.0054   -0.8020
```

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