```
clc;
close all;
clear;
%MPC HW 6 Aly Khater
%Problem 1

%Discrete Equation to get is th(k+1)=0.7788th(k)+0.0442q(k)+0.2212th_a(k)
%Model is th_dot=kq/T+th_a/T-th/T
%th_dot = (-1)th+(0.2)q+(1)th_a
A = -1;
B = [0.2 1];
C = 1;
D = zeros(1,2);
%Continous time system
sys_c = ss(A,B,C,D)
```

```
sys_c =

  A =
       x1
   x1  -1

  B =
        u1   u2
   x1  0.2    1

  C =
       x1
   y1   1

  D =
       u1  u2
   y1   0   0

Continuous-time state-space model.
Model Properties
```

```
% Discrete transform with sampling time
Ts = 0.25; %Sampling interval
T = 1; %Sampling period
sys_d = c2d(sys_c, Ts);
Bu = sys_d.B(:,1);     % control input q
Bd = sys_d.B(:,2);     % disturbance input theta_a
Du = sys_d.D(:,1);
Dd = sys_d.D(:,2);
```

```
%Convert to MOD format
pmod = ss2mod(sys_d.a, sys_d.b, sys_d.c, sys_d.d, Ts)
```

```
pmod = 3×7
    0.2500    1.0000    2.0000         0         0    1.0000         0
       NaN    0.7788    0.0442    0.2212         0         0         0
         0    1.0000         0         0         0         0         0
```

```
%As you can see, we get the corresponding discrete model given in the
%prompt
```

```
% MPC Params for smpcon
Hp = 10;   % Prediction horizon
Hu = 3;    % Control horizon
ywt = ones(Hp,1);     % Output Weights
uwt = zeros(Hu,1);    % Control weights
% smpcon to get K_s

%Output should be K_s=[22.604,-17.604,-22.604]
Ks = smpccon(pmod, ywt, uwt, Hu, Hp)
```

```
Ks = 1×3
   22.6041  -17.6041  -22.6041
```