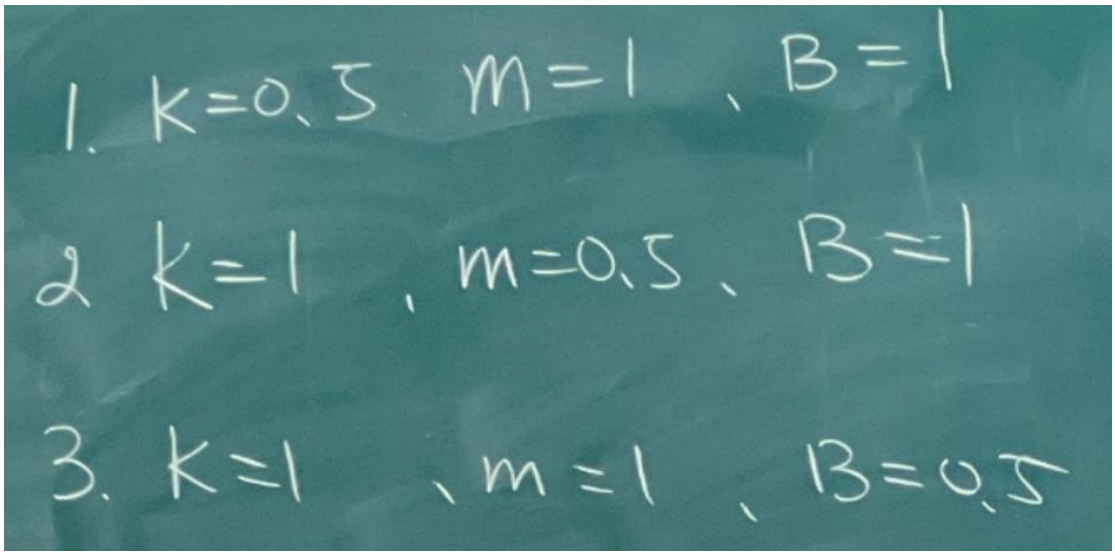


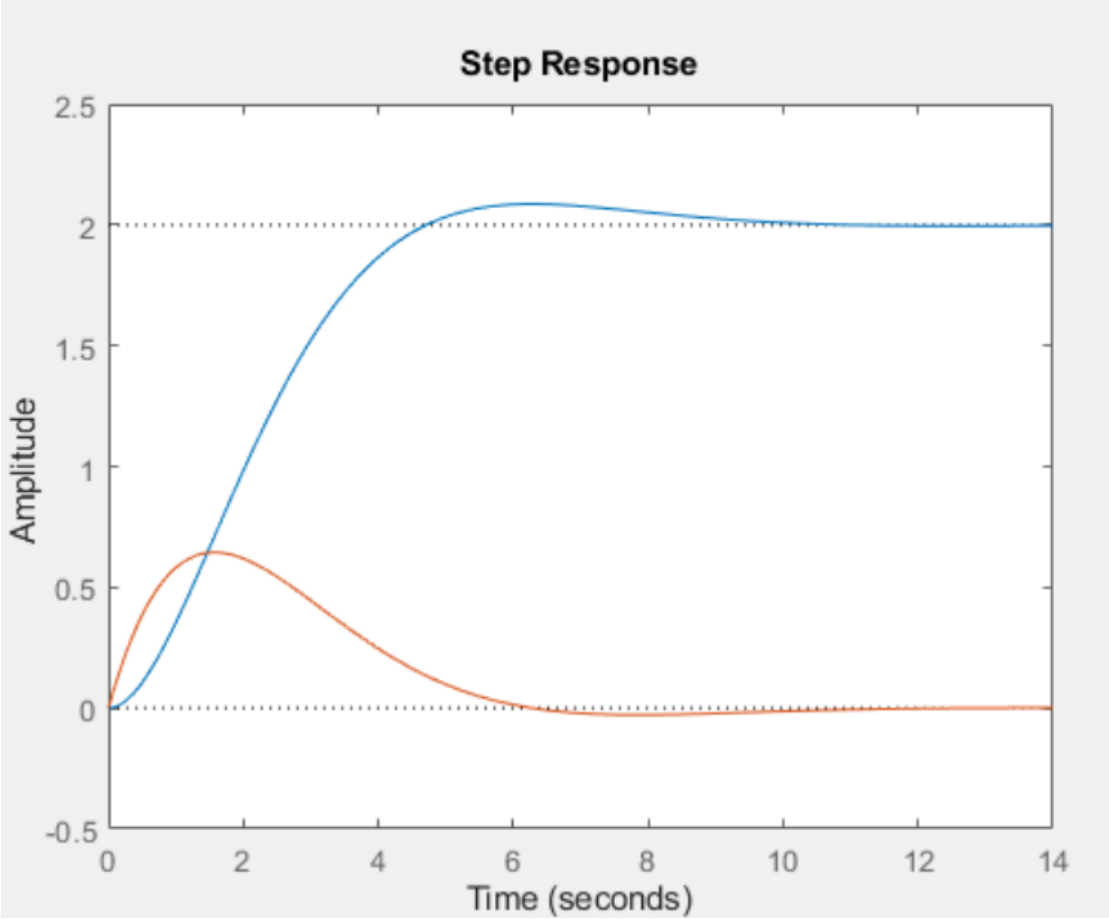
Editor - /Users/liyunru/Downloads/matlab2.m *

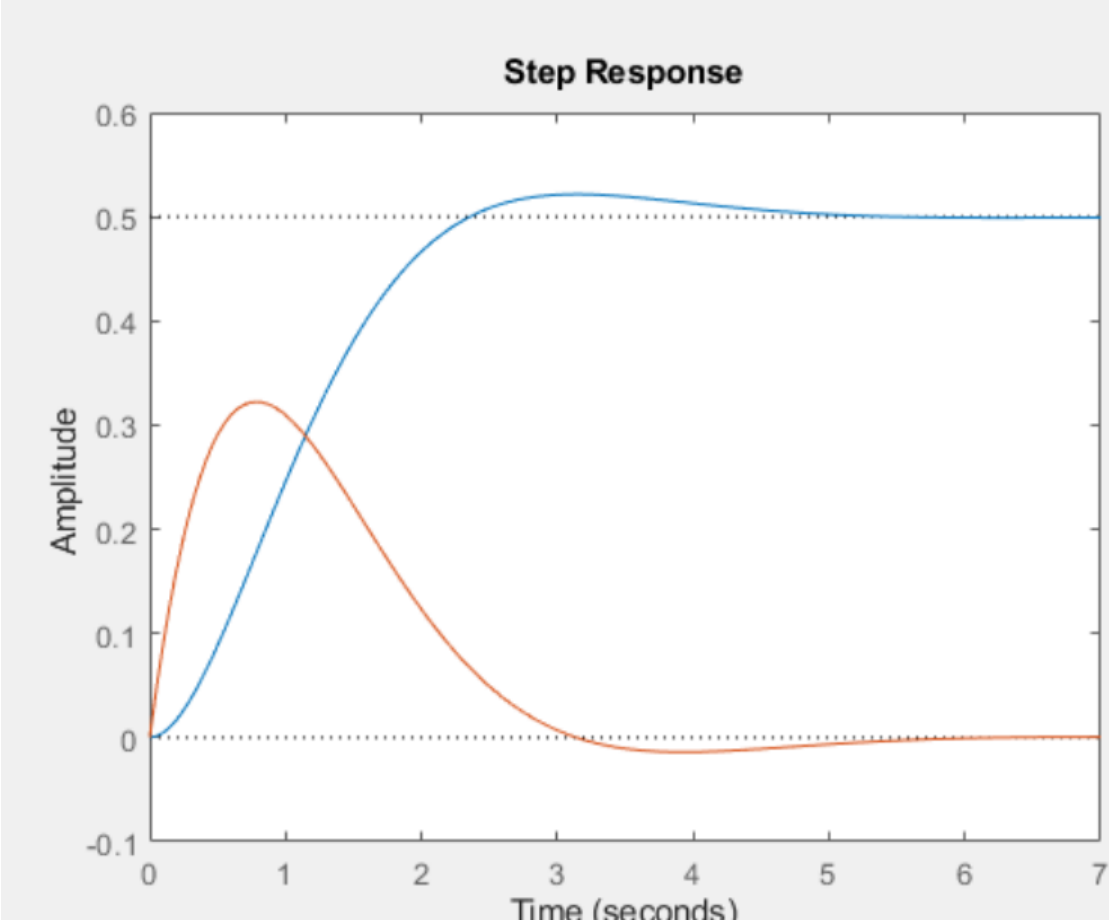
matlab2.m *

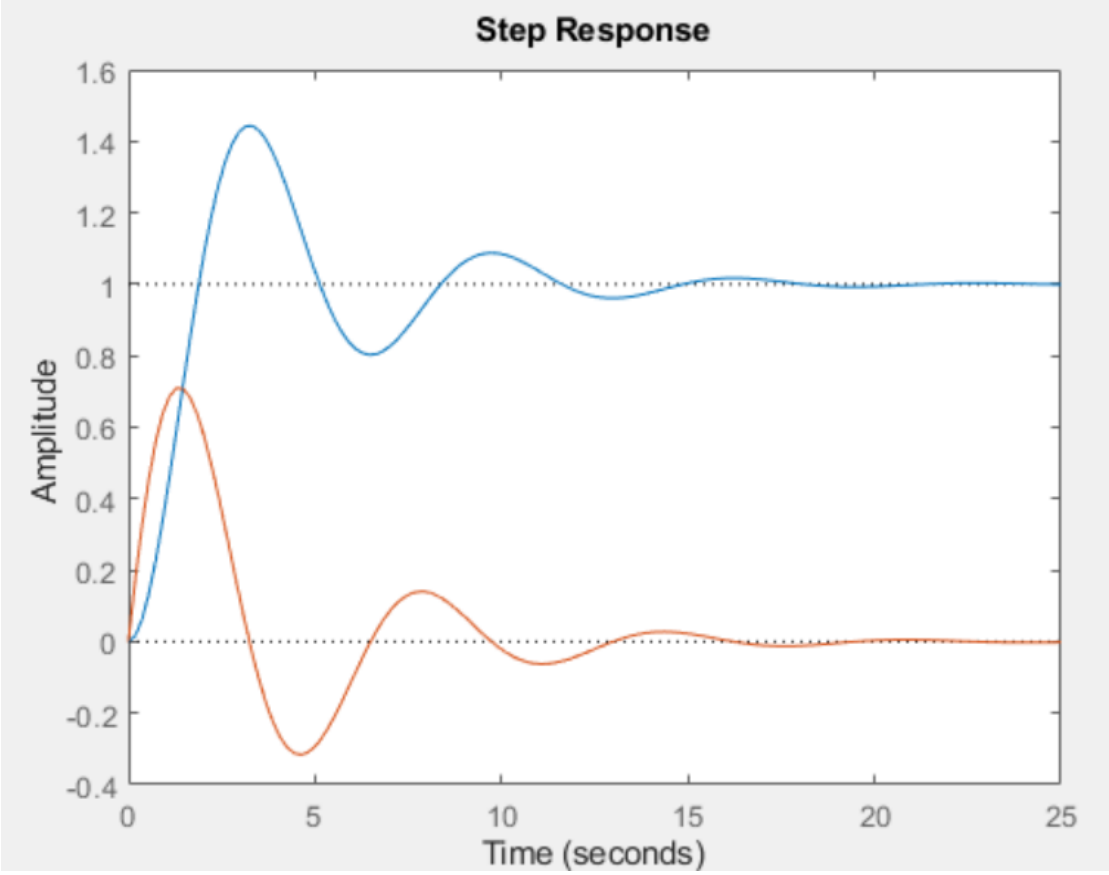
```
clc;    clear;

A = [0 1; -1 -0.5];
B = [0; 1];
C1 = [1 0];
C2 = [0 1];
D = 0;

figure(1)
hold onÍ›
step(A,B,C1,D);
step(A,B,C2,D);
hold off
```


Step Response
Amplitude
Time (seconds)
2.5
2
1.5
1
0.5
0
-0.5
0
2
4
6
8
10
12
14


Step Response
Amplitude
Time (seconds)
0.6
0.5
0.4
0.3
0.2
0.1
0
-0.1
0
1
2
3
4
5
6
7


Step Response
Amplitude
Time (seconds)
1.6
1.4
1.2
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
0
5
10
15
20
25

$m\dot{x}_2 + B x_2 + k x_1 = u$

x_1 (position)
x_2 (velocity)
$\dot{x}_2$ (acceleration)

$$\begin{bmatrix} \dot{x}_1 \\ \dot{x}_2 \end{bmatrix} = \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + \begin{bmatrix} b_1 \\ b_2 \end{bmatrix} u$$

$$y = \begin{bmatrix} c_1 & c_2 \end{bmatrix} \begin{bmatrix} x_1 \\ x_2 \end{bmatrix} + D$$

1. $k=0.5 \quad m=1 \quad B=1$

$\dot{x}_1 = a_{11} x_1 + a_{12} x_2 + b_1 u$ $\quad a_{11}=0,\ a_{12}=1,\ b_1=0$

$\dot{x}_2 = a_{21} x_1 + a_{22} x_2 + b_2 u$ $\quad a_{21}=\frac{-0.5}{1}=-0.5,\ a_{22}=\frac{-1}{1}=-1,\ b_2=1$

$$A=\begin{bmatrix} 0 & 1 \\ -0.5 & -1 \end{bmatrix} \quad B=\begin{bmatrix} 0 \\ 1 \end{bmatrix} \quad C_1=[1,0] \quad C_2=[0,1] \quad D=[0]$$

(1) $m\dot{x}_2 = -k x_1 - B x_2 + u$

$\Rightarrow \dot{x}_2 = \frac{-k}{m} x_1 - \frac{B}{m} x_2 + u$

---

2. $k=1 \quad m=0.5 \quad B=1$

$x_2 = a_{11} x_1 + a_{12} x_2 + b_1 u \Rightarrow a_{11}=0 \quad a_{12}=1 \quad b_1=0$

(1) $\dot{x}_2 = a_{21} x_1 + a_{22} x_2 + b_2 u \Rightarrow a_{21}=\frac{-1}{0.5}=-2 \quad a_{22}=\frac{-1}{0.5}=-2 \quad b_2=1$

$$\Rightarrow \begin{cases} \begin{bmatrix} 0 & 1 \\ -2 & -2 \end{bmatrix} \\ B=\begin{bmatrix} 0 \\ 1 \end{bmatrix} \end{cases} \quad C_1=[1\ 0] \quad C_2=[0\ 1] \quad D=[0]$$

---

3. $k=1 \quad m=1 \quad B=0.5$

$\dot{x}_2 = a_{11} x_1 + a_{12} x_2 + b_1 u \quad a_{11}=0 \quad a_{12}=1 \quad b_1=0$

$\dot{x}_2 = a_{21} x_1 + a_{22} x_2 + b_2 u \quad a_{21}=\frac{-1}{1}=-1 \quad a_{22}=\frac{-0.5}{1}=-0.5 \quad b_2=1$

(1) $m\dot{x}_2 = -k x_1 - B x_2 + u \Rightarrow \dot{x}_2 = \frac{-k}{m} x_1 - \frac{B}{m} x_2 + u$

$$\Rightarrow \begin{cases} A=\begin{bmatrix} 0 & 1 \\ -1 & -0.5 \end{bmatrix} \\ B=\begin{bmatrix} 0 \\ 1 \end{bmatrix} \end{cases}$$

$C_1=[1,0]$
$C_2=[0,1]$
$D=[0]$