Experiment 1: TRANSFER FUNCTION

Write the MATLAB Program to obtain the transfer function of the given system

EXAMPLE 1:

```
num = [200 400]
den = [1 10 100 0]
sys = tf (num,den)
```

```
sys =

       200 s + 400
  ---------------------
  s^3 + 10 s^2 + 100 s
```

EXAMPLE 2:

```
num = [1 0.2 0.048]
den = [2 56 289]
sys = tf (num,den)
```

```
sys =

  s^2 + 0.2 s + 0.048
  --------------------
  2 s^2 + 56 s + 289
```

To find roots of denominator of the transfer function

EXAMPLE 3:

```
num = [200 400]
den = [1 10 100 0]
sys = tf (num,den)
roots(den)
```

```
sys =

      200 s + 400
  --------------------
  s^3 + 10 s^2 + 100 s

Continuous-time transfer function.
Model Properties

ans = 3×1 complex

     0.0000 + 0.0000i
    -5.0000 + 8.6603i
    -5.0000 - 8.6603i
```

Experiment 2: TIME RESPONSE

Implementation of Time Response of a System Using MATLAB for the given system function.

EXAMPLE 3:

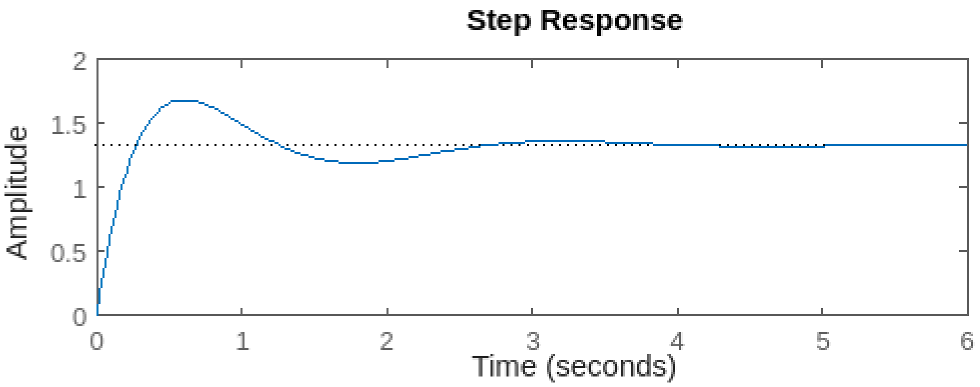
Transfer Function:

```
sys =

      8 s^2 + 18 s + 32
  -------------------------
  s^3 + 6 s^2 + 14 s + 24
```

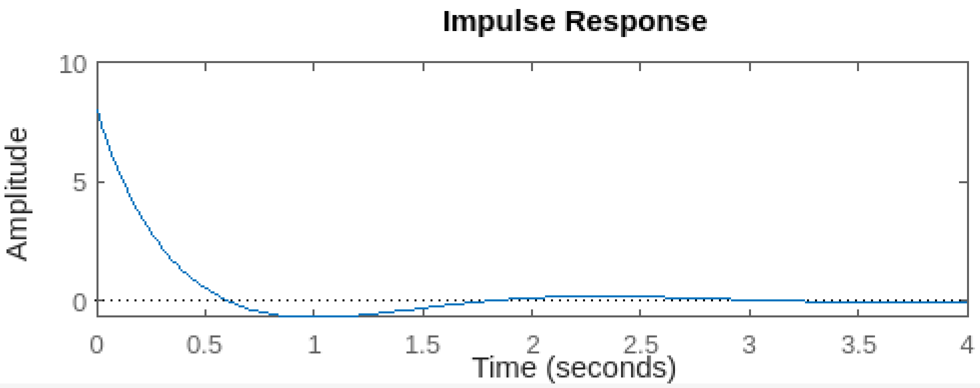
CODE:

```
num = [8 18 32]
den = [1 6 14 24]
sys=tf(num,den)
subplot(2,1,1)
step(sys)
subplot(2,1,2)
impulse(sys)
t = 0:0.01:4;
u = sin(10*t);
lsim(sys,u,t)
```

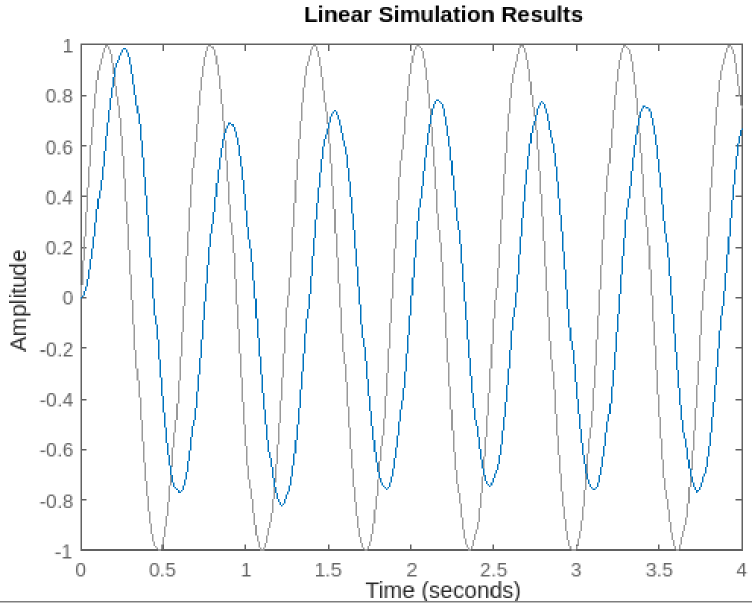
OUTPUT:



Step Response
Amplitude
Time (seconds)
0
0.5
1
1.5
2
0
1
2
3
4
5
6



Impulse Response
Amplitude
Time (seconds)
0
5
10
0
0.5
1
1.5
2
2.5
3
3.5
4



Linear Simulation Results
Amplitude
Time (seconds)
1
0.8
0.6
0.4
0.2
0
-0.2
-0.4
-0.6
-0.8
-1
0
0.5
1
1.5
2
2.5
3
3.5
4

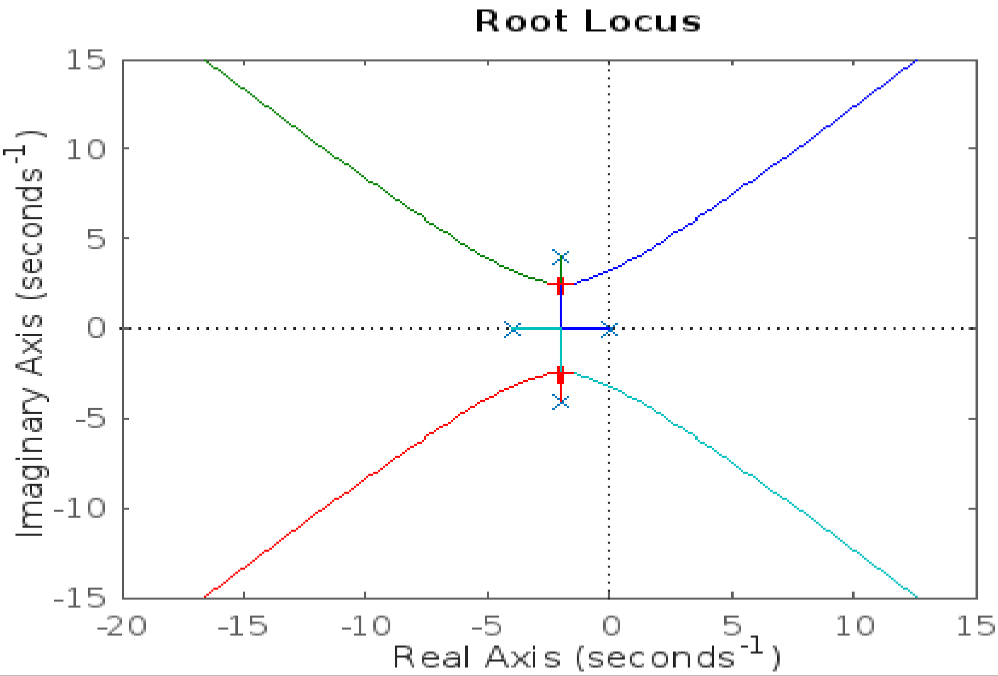
Experiment 3: ROOT LOCUS

Write the MATLAB Program to plot root locus diagram of an open loop transfer function and Determine range of gain ‘K’ for stability.

EXAMPLE 1:

```
num = 1
den = [1 8 36 80 0]
sys = tf(num,den)
rlocus(sys)
[K,poles] = rlocfind(sys)
[K,poles] = rlocfind(sys)
```

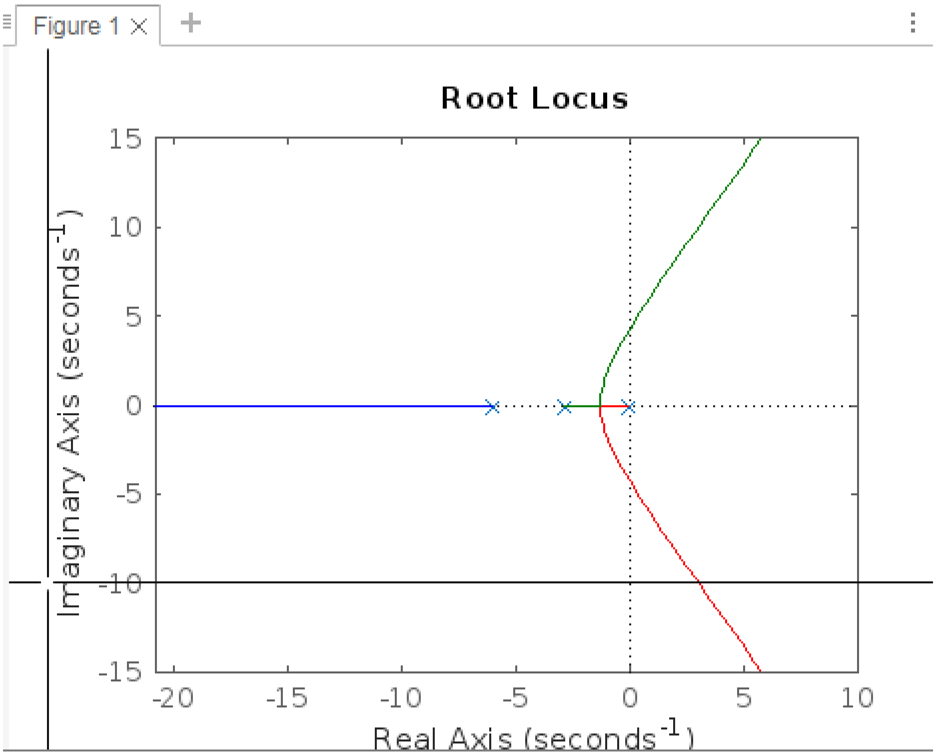
```
sys =

                 1
   ----------------------------
   s^4 + 8 s^3 + 36 s^2 + 80 s

Continuous-time transfer function.
Model Properties
Select a point in the graphics window
selected_point = -2.3017 - 2.7881i
K = 100.1596
poles = 4x1 complex
     -2.0815 + 2.4508i
     -2.0815 - 2.4508i
     -1.9185 + 2.4508i
     -1.9185 - 2.4508i
```



EXAMPLE 2:

```
num = [1]
den = [1 9 18 1]
sys = tf(num,den)
rlocus(sys)
[K,poles] = rlocfind(sys)
[K,poles] = rlocfind(sys)
```

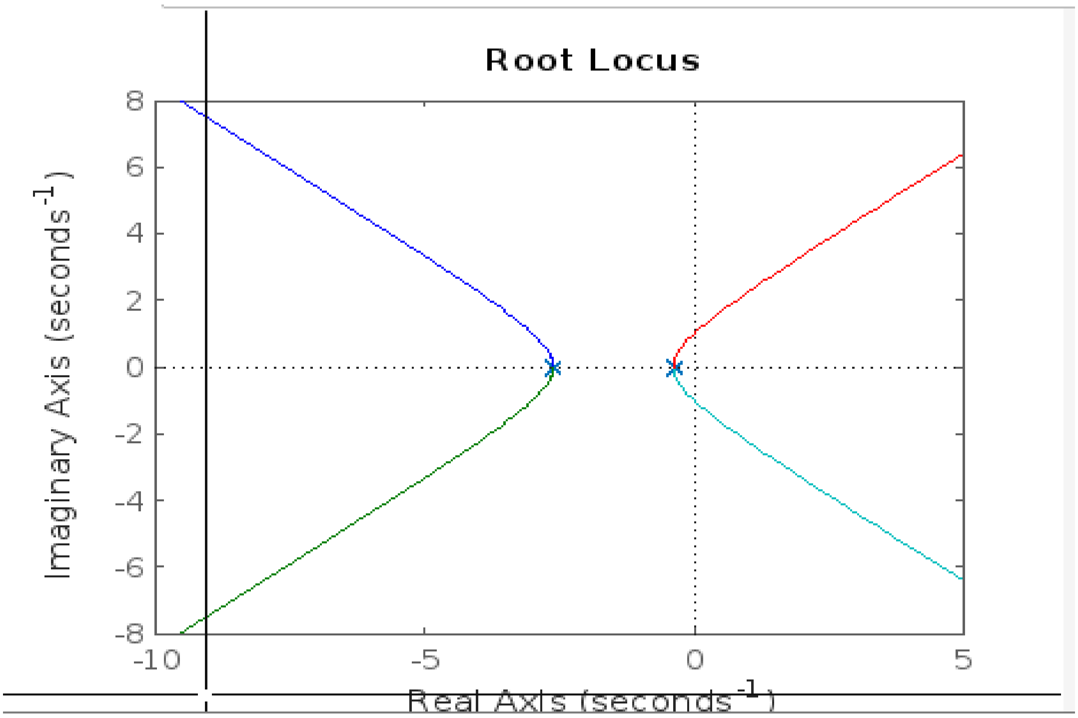
```
sys =

              1
    ----------------------
    s^3 + 9 s^2 + 18 s + 1
```



EXAMPLE 3:

```
num = [1]
den = [1 6 11 6 1]
sys = tf(num,den)
rlocus(sys)
[K,poles] = rlocfind(sys)
[K,poles] = rlocfind(sys)
```

```
sys =

                    1
  ----------------------------
  s^4 + 6 s^3 + 11 s^2 + 6 s + 1
```



EXAMPLE 4:

```
num = [1 4]
den = [1 2 3 4]
sys = tf(num,den)
rlocus(sys)
[K,poles] = rlocfind(sys)
[K,poles] = rlocfind(sys)
```

```
sys =

        s + 4
  -----------------------
  s^3 + 2 s^2 + 3 s + 4
```

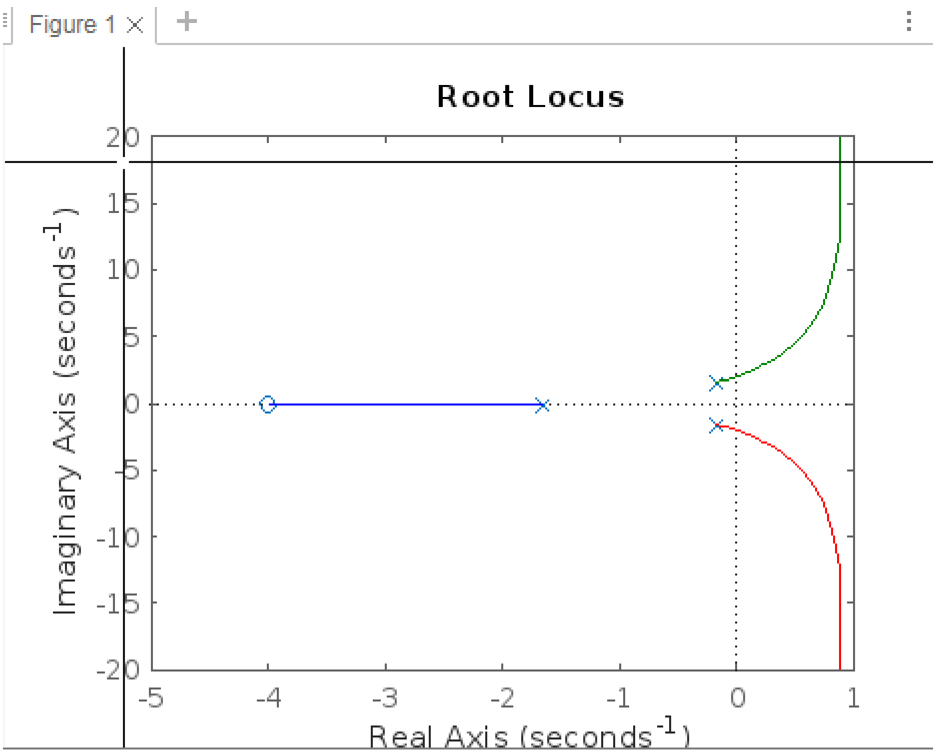


Figure 1
Root Locus
Imaginary Axis (seconds^{-1})
Real Axis (seconds^{-1})
20
15
10
5
0
-5
-10
-15
-20
-5
-4
-3
-2
-1
0
1

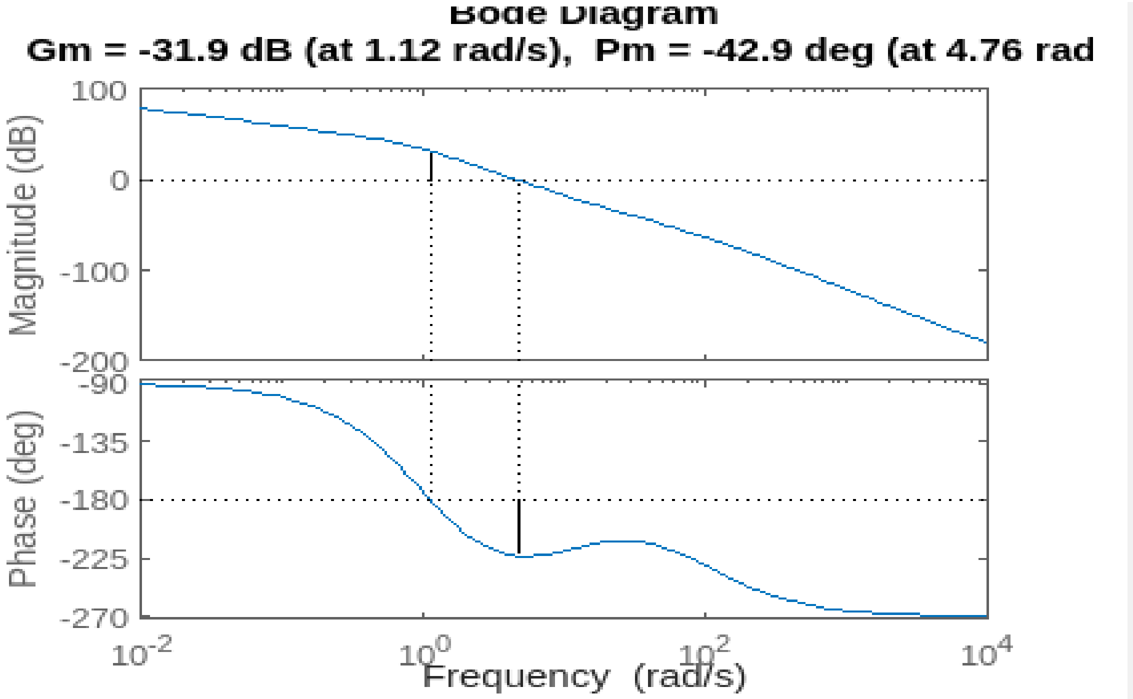
Experiment 4: BODE PLOT

Write a MATLAB code to plot a Bode diagram of an open loop transfer function.

EXAMPLE 1:

```
num = [10 100]
den = [.01 1 2.03 1 0]
sys = tf (num,den)
[gm,pm,wcg,wcp] = margin(sys)
margin(sys)
```

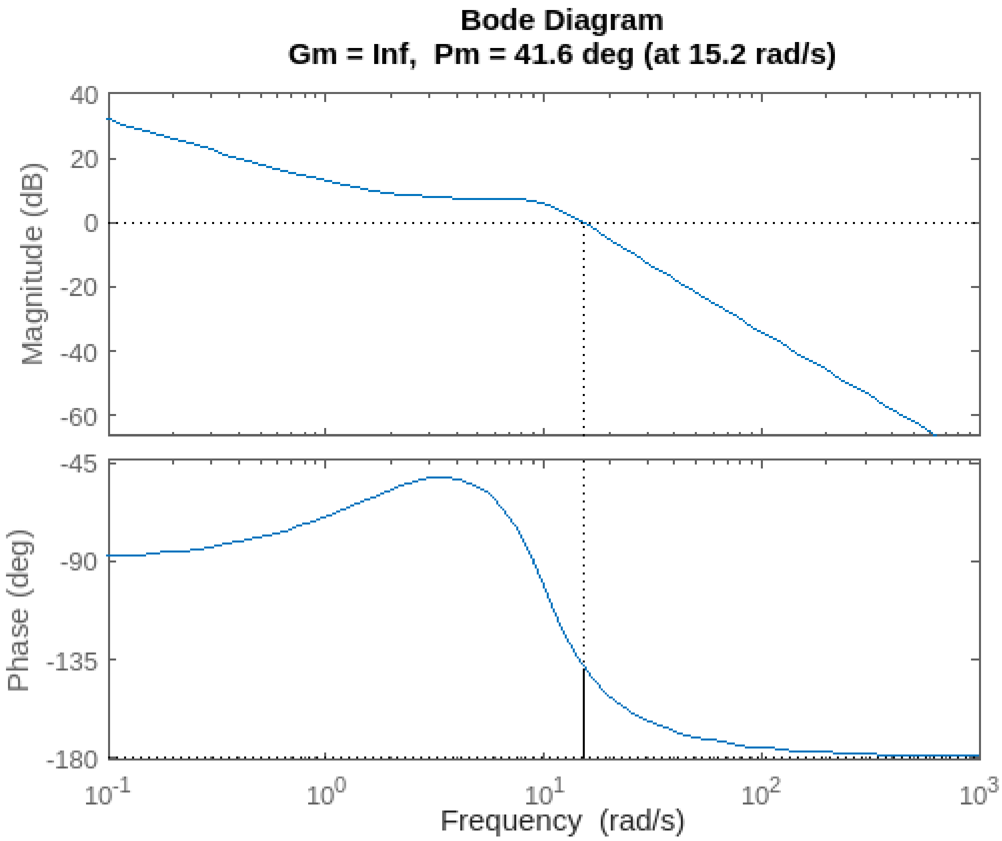
```
sys =

            10 s + 100
  -------------------------------
  0.01 s^4 + s^3 + 2.03 s^2 + s

Continuous-time transfer function.
Model Properties

Warning: The closed-loop system is unstable.

gm = 0.0253

pm = -42.9220

wcg = 1.1193

wcp = 4.7578
```



EXAMPLE 2:

```
num = [200 400]
den = [1 10 100 0]
sys = tf (num,den)
[gm,pm,wcg,wcp] = margin(sys)
margin(sys)
```

```
sys =

      200 s + 400
  --------------------
  s^3 + 10 s^2 + 100 s

Continuous-time transfer function.
Model Properties
gm = Inf
pm = 41.5822
wcg = Inf
wcp = 15.2373
```



EXAMPLE 3:

```
num = [1 45 200]
den = [1 1200 20000 0 0]
sys = tf (num,den)
[gm,pm,wcg,wcp] = margin(sys)
margin(sys)
```

```
sys =

        s^2 + 45 s + 200
  --------------------------
  s^4 + 1200 s^3 + 20000 s^2

Continuous-time transfer function.
Model Properties

gm = 0

pm = 0.9453

wcg = 0

wcp = 0.1000
```