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Assignment: 0

Dec 4

Part - A

1.1 $G_1(s) = \frac{10}{s+10}$

Zero $\Rightarrow$ Zero is not present

$s = -10$ (pole)

Corner frequency $\Rightarrow$ $G_1(j\omega) \frac{10}{j\omega+10} = \frac{1}{\frac{j\omega}{10}+1}$

Corner frequency $(\omega_c) = 10$ rad/s

For $\omega < 10$

$M = 1$

$dB = 20\log 1$

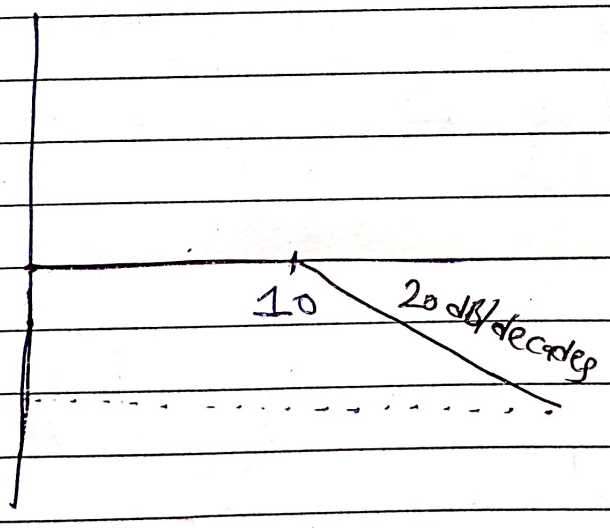
$= 0$

For $\omega > 0$

$M = \frac{10}{j\omega}$

$dB = 20\log 10 - 20\log\omega$

$dB = 20 - 20\log\omega$



$G_1(0) = 1$

1.2

$G_2(s) = \frac{s-2}{s+10}$ Zero at 2
Pole at -10.

$G_2(s) = \frac{2\left(\frac{s}{2}-1\right)}{10\left(\frac{s}{10}+1\right)}$ ~~for~~

Corner frequency(ω_c) $\Rightarrow$ 2, 10

$G_2(s) = \frac{0.2\left(\frac{s}{2}-1\right)}{\left(\frac{s}{10}+1\right)}$ $\Rightarrow$ $\frac{0.2\left(\frac{j\omega}{2}-1\right)}{\left(\frac{j\omega}{10}+1\right)}$

2, 10

$\omega < 2$

$M = -0.2$

$2 < \omega < 10$

$M = \frac{0.2\left(\frac{j\omega}{2}\right)}{1}$ $\Rightarrow$ $\frac{0.1j}{\frac{j\omega}{10}}$

$\omega > 10$

$M = \frac{0.2\left(\frac{j\omega}{2}\right)}{\left(\frac{j\omega}{10}\right)}$ $\Rightarrow$ 1.

$\omega < 2$

$dB = 20\log(|0.2|) \Rightarrow$

$\Rightarrow 20\log 2 - 20$

$2 < \omega < 10$

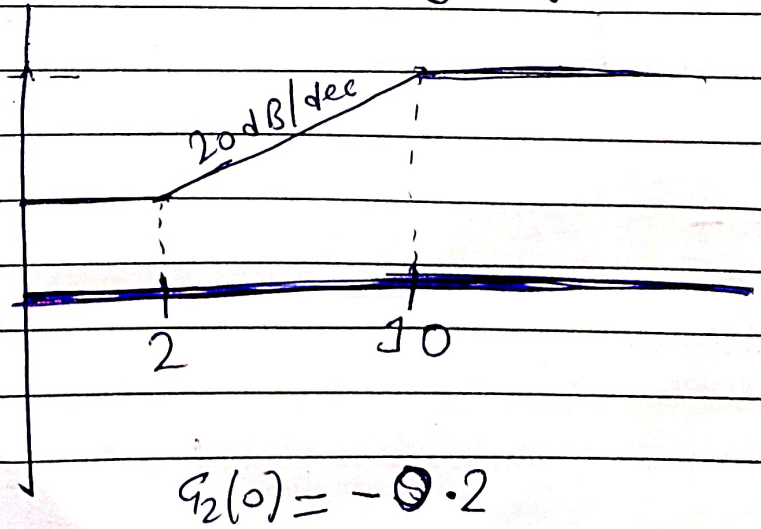
$dB = 20\log\left(\frac{j\omega}{10}\right)$

$\Rightarrow 20\log(j\omega) - 20$

$\omega > 10$

$dB = 20\log 1$

$= 0$



$G_2(0) = -0.2$

1.3

Date

$G_3(s) = \frac{100}{s^2+10s+100}$ no zero present

$s = \frac{-10 \pm \sqrt{10^2-4\cdot100}}{2} = -5 \pm j5\sqrt{3}$

Pole: $-5 \pm j5\sqrt{3}$

$G_3(s) = \frac{100}{(s+5)^2+75} = \frac{100}{25\left(\frac{s}{5}+1\right)^2+75}$

$\Rightarrow \frac{100}{25\left(\frac{s}{5}+1\right)^2+75} \Rightarrow \frac{4}{\left(\frac{s}{5}+1\right)^2+3}$

Corner frequency $|\omega_c| = 5$

$G_3(s) = \frac{100}{s^2+10s+100}$

$G_3(j\omega) = \frac{100}{(j\omega)^2+10j\omega+100} \Rightarrow \frac{1}{\left(\frac{j\omega}{10}\right)^2+\frac{j\omega}{10}+1}$

Corner frequency $|\omega_c| = 10$

$\omega < 0$

$M = 1$

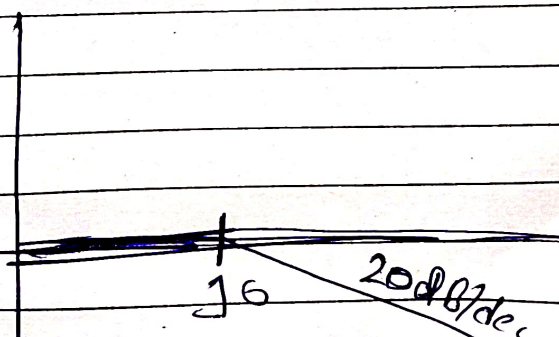
$dB = 0$

$\omega > 10$

$M = \frac{1}{\left(\frac{j\omega}{10}\right)^2+\frac{j\omega}{10}} \Rightarrow \frac{10}{j\omega}$

$dB = 20 - 20 \log \omega$

$G_3(0) = 1$



1.4

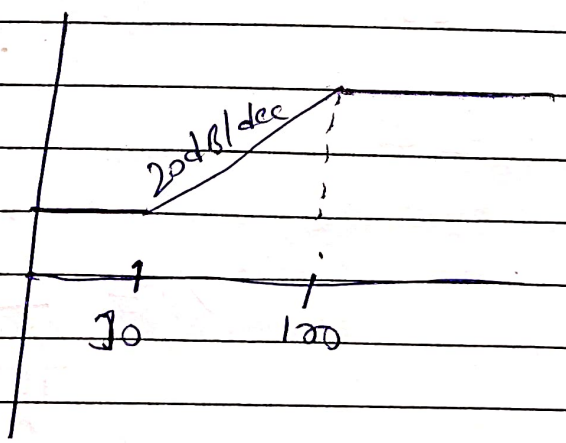
$$G_4(s) = \frac{0.1s+1}{0.01s+1} \Rightarrow$$ Zero : @ -10, Pole = -100

$$G_4(s) = \frac{\frac{s}{10}+1}{\frac{s}{100}+1}$$ Corner frequency 10, 100

$$G_4(j\omega) = \frac{\frac{j\omega}{10}+1}{\frac{j\omega}{100}+1}$$

$\omega < 10$	$10 < \omega < 100$	$\omega > 100$
$M = 1$	$M = \frac{j\omega}{10}$	$M = 10$
$dB = 20\log 1$	$dB = 20\log\omega - 20$	$M = 20$
$= 0$		

$G_4(0) = 1$



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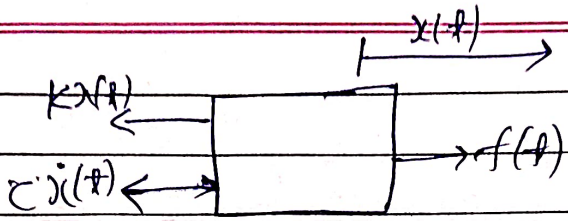
B.1.



$\frac{dx}{dt} = \dot{x}$

1.

$$F(t) - Kx(t) - C\dot{x}(t) = m\ddot{x}(t)$$
$$f(t) = Kx(t) + C\dot{x}(t) + m\ddot{x}(t)$$

2. Laplace-domain

$$ms^2X(s) + csX(s) + KX(s) = F(s)$$

3.

$$G(s) = \frac{F(s)}{X(s)} = \frac{1}{ms^2 + cs + K}$$

B-2

$$G(s) = \frac{X(s)}{F(s)} = \frac{1}{ms^2 + ds + c}$$

$m = 1\,kg$

$d = 4\,N.s/m$

$c = 16\,N/m$

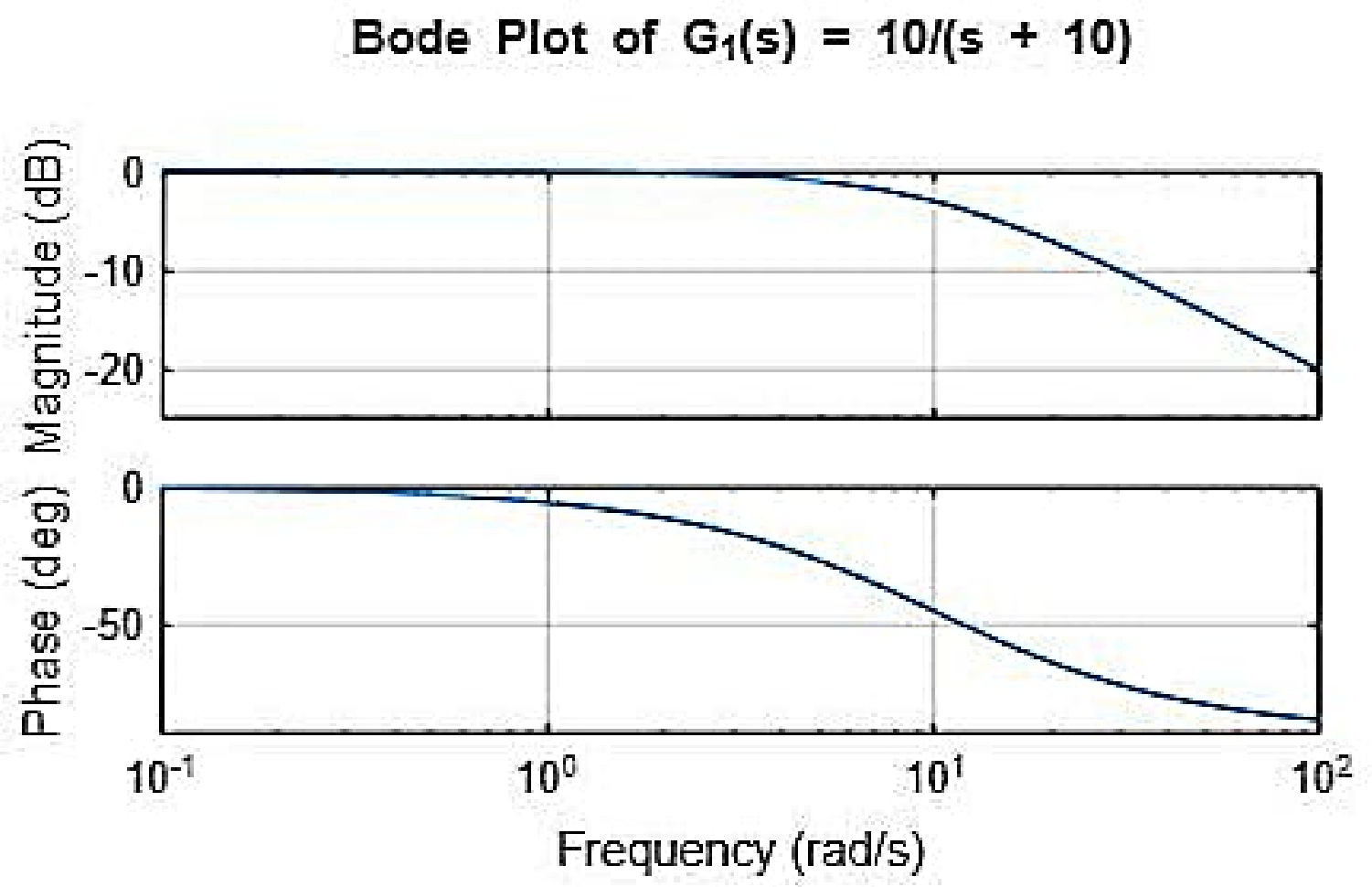
$$G_1(s) = \frac{1}{s^2 + 4s + 16}$$

$$s_{1,2} = \frac{-4 \pm \sqrt{16 - 4 \cdot 16}}{2} = \frac{-4 \pm \sqrt{-48}}{2}$$

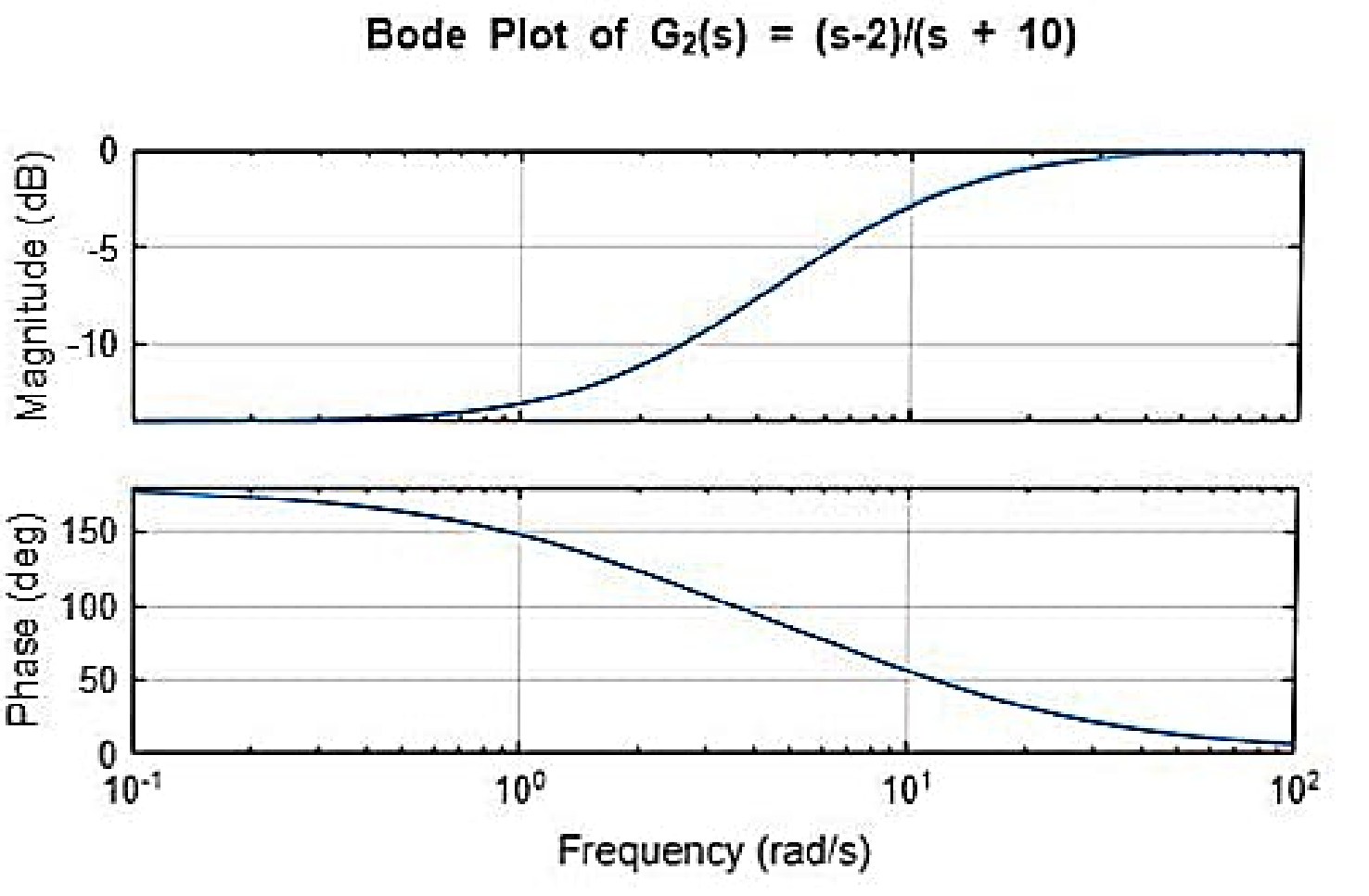
$$s_{1,2} = -2 \pm j2\sqrt{3}$$

$$G(0) = \frac{1}{16}$$

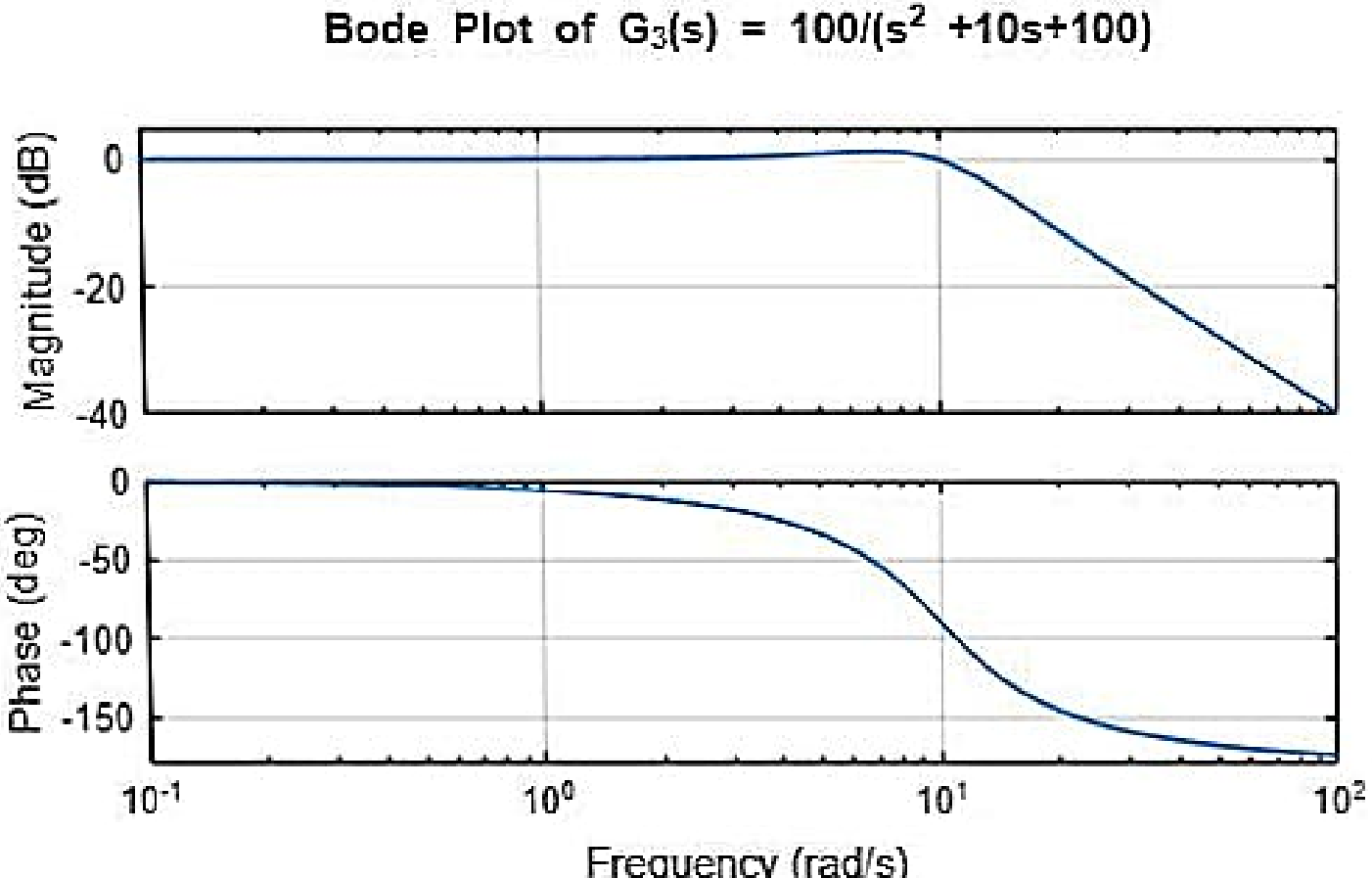
De gain $= \frac{1}{16}$


Bode Plot of G1(s) = 10/(s + 10)
Magnitude (dB)
0
-10
-20
Phase (deg)
0
-50
10-1
100
101
102
Frequency (rad/s)

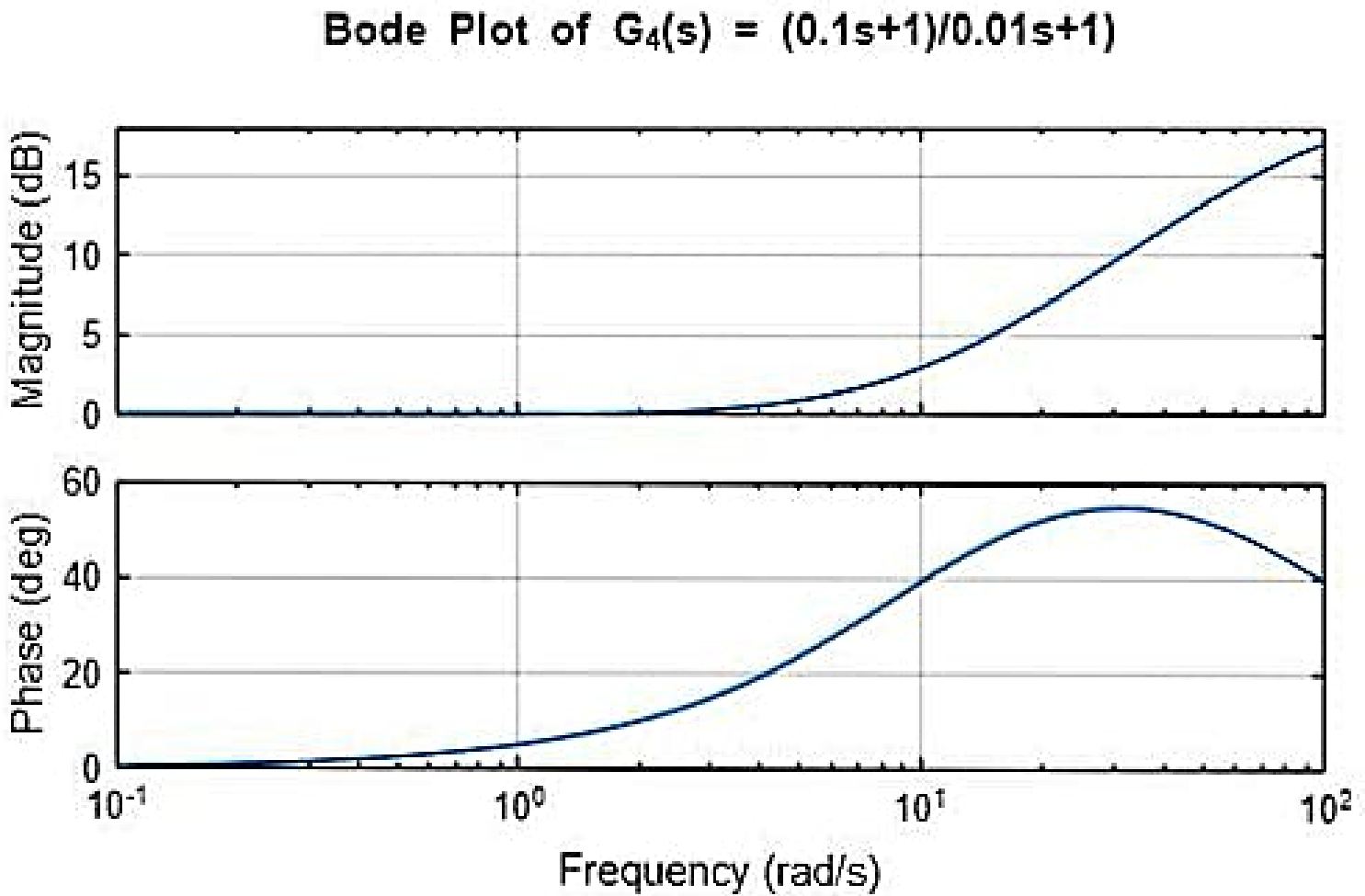
```
s = tf('s');
G1 = 10/(s + 10);

w = logspace(-1, 2, 500);  % Frequency range: 0.1 to 100 rad/s

figure;
bode(G1, w);
grid on;
title('Bode Plot of G_1(s) = 10/(s + 10)');
```


Bode Plot of G2(s) = (s-2)/(s + 10)
Magnitude (dB)
0
-5
-10
Phase (deg)
150
100
50
0
10-1
100
101
102
Frequency (rad/s)

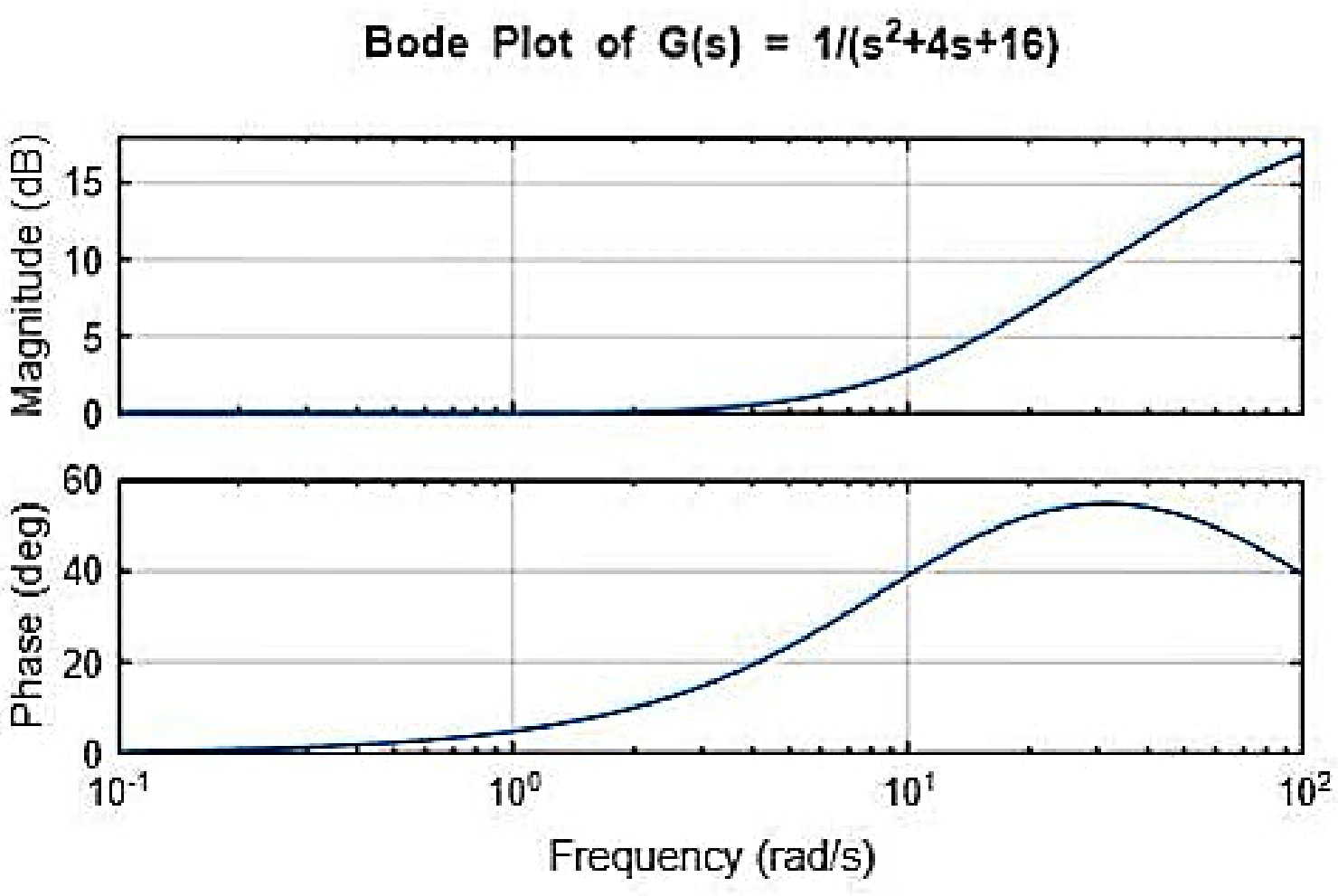
```
s = tf('s');
G2 = (s-2)/(s + 10);

w = logspace(-1, 2, 500);  % Frequency range: 0.1 to 100 rad/s

figure;
bode(G2, w);
grid on;
title('Bode Plot of G_2(s) = (s-2)/(s + 10)');
```


Bode Plot of G3(s) = 100/(s2 +10s+100)
Magnitude (dB)
0
-20
-40
Phase (deg)
0
-50
-100
-150
10-1
100
101
102
Frequency (rad/s)

```
s = tf('s');
G3 = 100/(s^2 +10*s+100);

w = logspace(-1, 2, 500);  % Frequency range: 0.1 to 100 rad/s

figure;
bode(G3, w);
grid on;
title('Bode Plot of G_3(s) = 100/(s^2 +10s+100)');
```


Bode Plot of G4(s) = (0.1s+1)/0.01s+1)
Magnitude (dB)
15
10
5
0
Phase (deg)
60
40
20
0
10-1
100
101
102
Frequency (rad/s)

```
s = tf('s');
G4 = (0.1*s+1)/(0.01*s+1);

w = logspace(-1, 2, 500);  % Frequency range: 0.1 to 100 rad/s

figure;
bode(G4, w);
grid on;
title('Bode Plot of G_4(s) = (0.1s+1)/0.01s+1)');
```


Bode Plot of G(s) = 1/(s2+4s+16)
Magnitude (dB)
15
10
5
0
Phase (deg)
60
40
20
0
10-1
100
101
102
Frequency (rad/s)

```
s = tf('s');
G =1/(s^2+4*s+16);

w = logspace(-1, 2, 500);  % Frequency range: 0.1 to 100 rad/s

figure;
bode(G4, w);
grid on;
title('Bode Plot of G(s) = 1/(s^2+4s+16)');
```