Chapter 10 problems, 1, 2 & 4

In problem 4, you responsible for the sketching of the magnitude plots as shown (the sketches here are done identically to what we did in class).

You are responsible for the sketching of the phase plots ONLY as shown in class. The sketches of the phase plots presented here use the methods shown in class and some more advanced techniques.

Answers to Problems

1. a.

$$G(s) = \frac{1}{(s+2)(s+4)}; \quad G(j\omega) = \frac{1}{(8-\omega^2)+j\cdot 6\omega}$$

$$M(\omega) = \frac{1}{\sqrt{(8-\omega^2)^2+(6\omega)^2}};$$

For $\omega < \sqrt{8}$

$$\Phi(\omega) = -\arctan\left(\frac{6\omega}{8-\omega^2}\right)$$

For $\omega > \sqrt{8}$

$$\Phi(\omega) = -\left(\pi + \arctan\left[\frac{6\omega}{8-\omega^2}\right]\right)$$

b.

$$G(s) = \frac{1}{s(s+2)(s+4)}; \quad G(j\omega) = \frac{1}{-6\omega^2+j(8\omega-\omega^3)}$$

$$M(\omega) = \frac{1}{\sqrt{(8\omega-\omega^3)^2+(6\omega^2)^2}}; \quad \Phi(\omega) = -\left(\pi + \arctan\left[\frac{8-\omega^2}{-6\omega}\right]\right)$$

c.

$$G(s) = \frac{(s+5)}{(s+2)(s+4)}; \quad G(j\omega) = \frac{(\omega^2+40)-j(\omega^2+22)\omega}{\omega^4+20\omega^2+64}$$

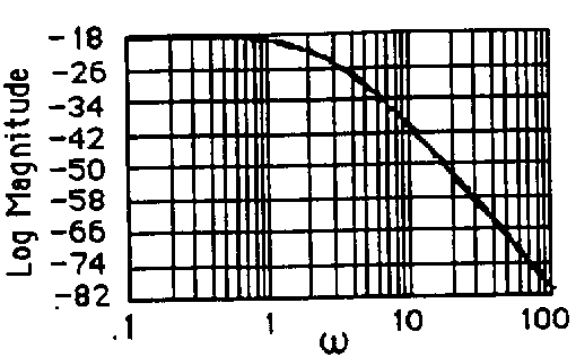
$$M(\omega) = \frac{\sqrt{(\omega^2+40)^2+\omega^2(\omega^2+22)^2}}{\omega^4+20\omega^2+64}; \quad \Phi(\omega) = \arctan\left(\frac{-[\omega^2+22]\omega}{\omega^2+40}\right)$$

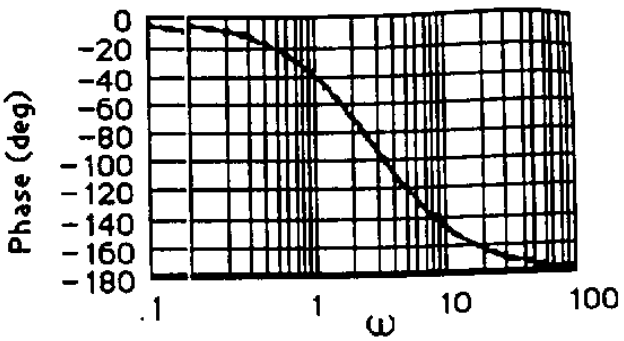
d.

$$G(s) = \frac{(s+3)(s+5)}{s(s+4)(s+2)}; \quad G(j\omega) = \frac{-2\omega(\omega^2+13)-j(\omega^4+25\omega^2+120)}{\omega^5+20\omega^3+64\omega}$$

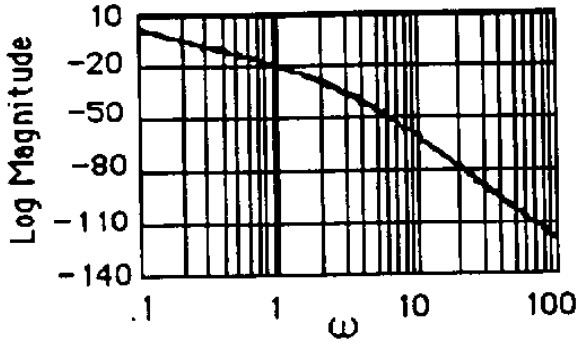
$$M(\omega) = \frac{\sqrt{(2\omega[\omega^2+13])^2+(\omega^4+25\omega^2+120)^2}}{\omega^5+20\omega^3+64\omega}; \quad \Phi(\omega) = \pi + \arctan\left(\frac{\omega^4+25\omega^2+120}{2\omega[\omega^2+13]}\right)$$

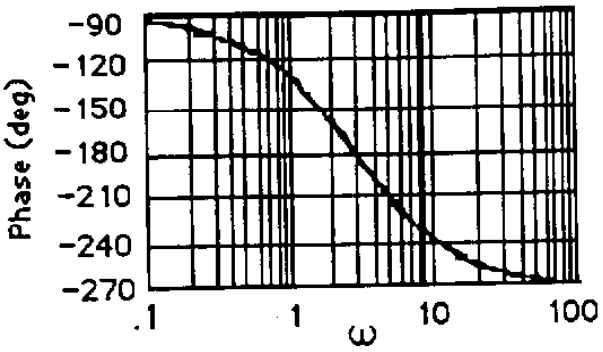
2. a.


Log Magnitude
-18
-26
-34
-42
-50
-58
-66
-74
-82
.1
1
10
100
ω

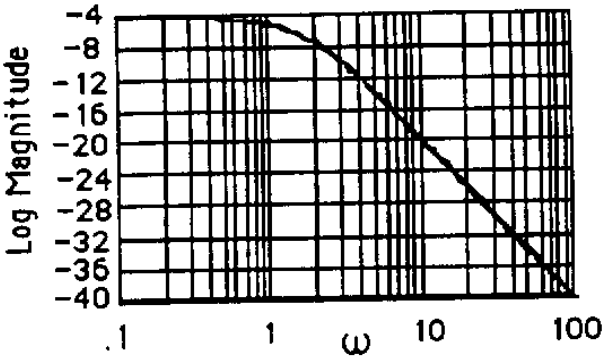

Phase (deg)
0
-20
-40
-60
-80
-100
-120
-140
-160
-180
.1
1
10
100
ω

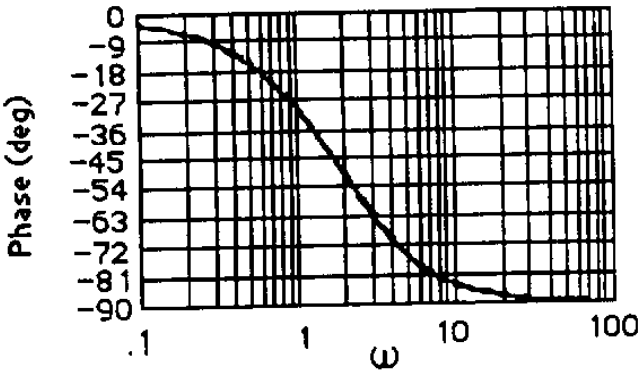
b.


Log Magnitude
10
-20
-50
-80
-110
-140
.1
1
10
100
ω

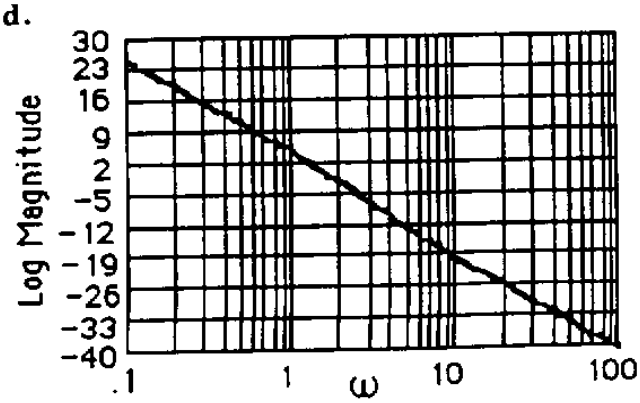

Phase (deg)
-90
-120
-150
-180
-210
-240
-270
.1
1
10
100
ω

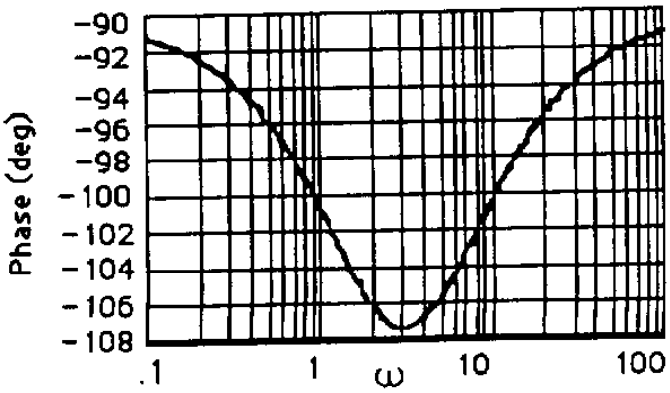
c.


Log Magnitude
-4
-8
-12
-16
-20
-24
-28
-32
-36
-40
.1
1
10
100
ω

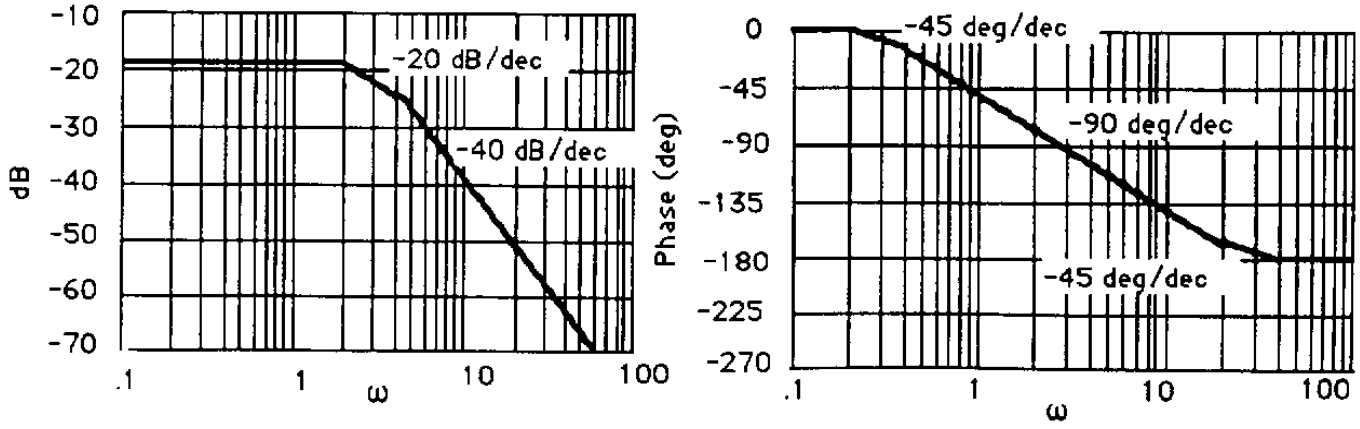

Phase (deg)
0
-9
-18
-27
-36
-45
-54
-63
-72
-81
-90
.1
1
10
100
ω

d.

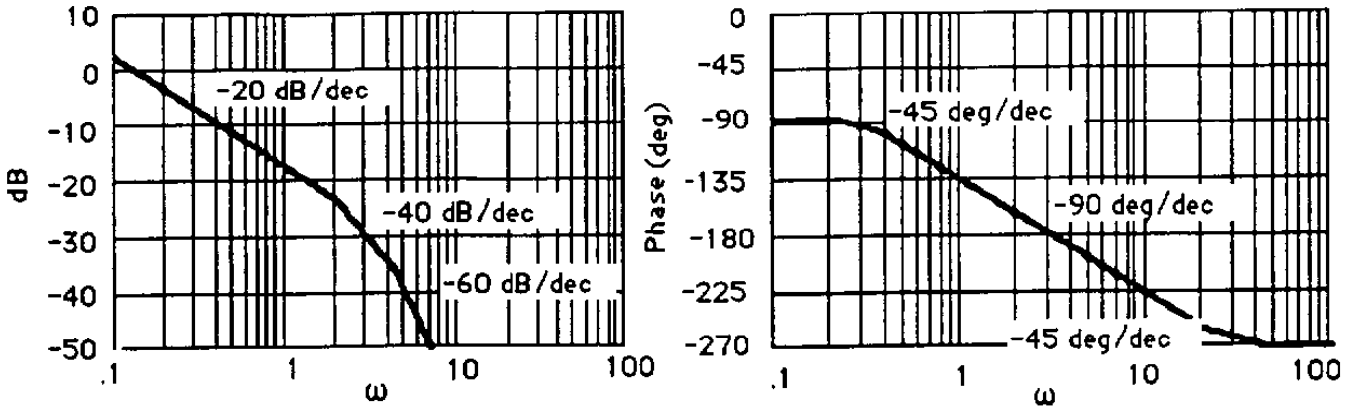

Log Magnitude
30
23
16
9
2
-5
-12
-19
-26
-33
-40
.1
1
10
100
ω


Phase (deg)
-90
-92
-94
-96
-98
-100
-102
-104
-106
-108
.1
1
10
100
ω

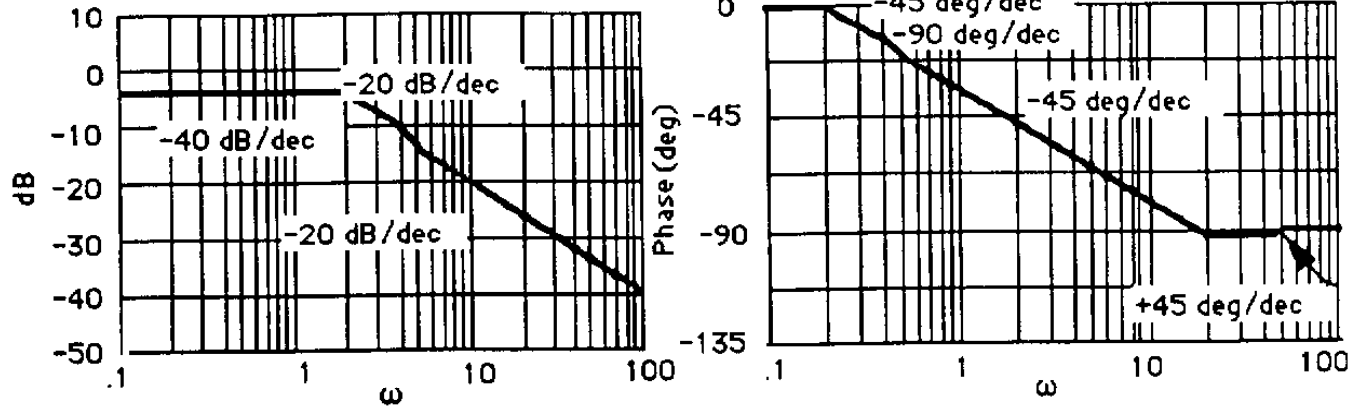
4. a.


-10
-20
-30
-40
-50
-60
-70
dB
-20 dB/dec
-40 dB/dec
.1
1
10
100
ω
0
-45
-90
-135
-180
-225
-270
Phase (deg)
-45 deg/dec
-90 deg/dec
-45 deg/dec
.1
1
10
100
ω

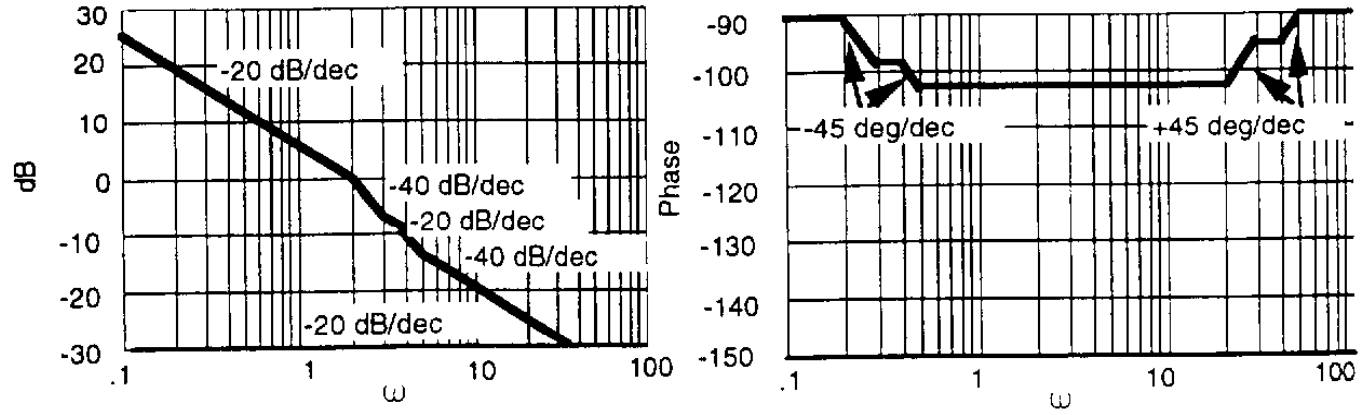
b.


10
0
-10
-20
-30
-40
-50
dB
-20 dB/dec
-40 dB/dec
-60 dB/dec
.1
1
10
100
ω
0
-45
-90
-135
-180
-225
-270
Phase (deg)
-45 deg/dec
-90 deg/dec
-45 deg/dec
.1
1
10
100
ω

c.


10
0
-10
-20
-30
-40
-50
dB
-20 dB/dec
-40 dB/dec
-20 dB/dec
.1
1
10
100
ω
0
-45
-90
-135
Phase (deg)
-45 deg/dec
-90 deg/dec
-45 deg/dec
+45 deg/dec
.1
1
10
100
ω

d.


30
20
10
0
-10
-20
-30
dB
-20 dB/dec
-40 dB/dec
-20 dB/dec
-40 dB/dec
-20 dB/dec
.1
1
10
100
ω
-90
-100
-110
-120
-130
-140
-150
Phase
-45 deg/dec
+45 deg/dec
.1
1
10
100
ω