EE228 Spring 2007

PS #18 Solutions

14.16 $$H(s) = \frac{10}{s(s^2+s+16)} = \frac{10/16}{s\left(\frac{s^2}{4^2}+\frac{s}{16}+1\right)}$$ ← no zeros ← origin pole + 2 complex poles

matching the quadratic with $\frac{s^2}{\omega_0^2} + \frac{2\zeta}{\omega_0}s + 1$

gives $\omega_0 = 4$ $\quad \frac{2\zeta}{4} = \frac{1}{16} \rightarrow \zeta = \frac{1}{8}$

Corner Freq: 4 Phase Breaks: 0.4 and 40

Initial Magnitude: $20\log_{10}\left(\frac{10}{16}\right) - 20\log_{10}\omega$

→ choose $\omega_{low} = 0.1$ so $20\log\left(\frac{10}{16}\right) - 20\log(.1)$
$= 15.92\,dB$

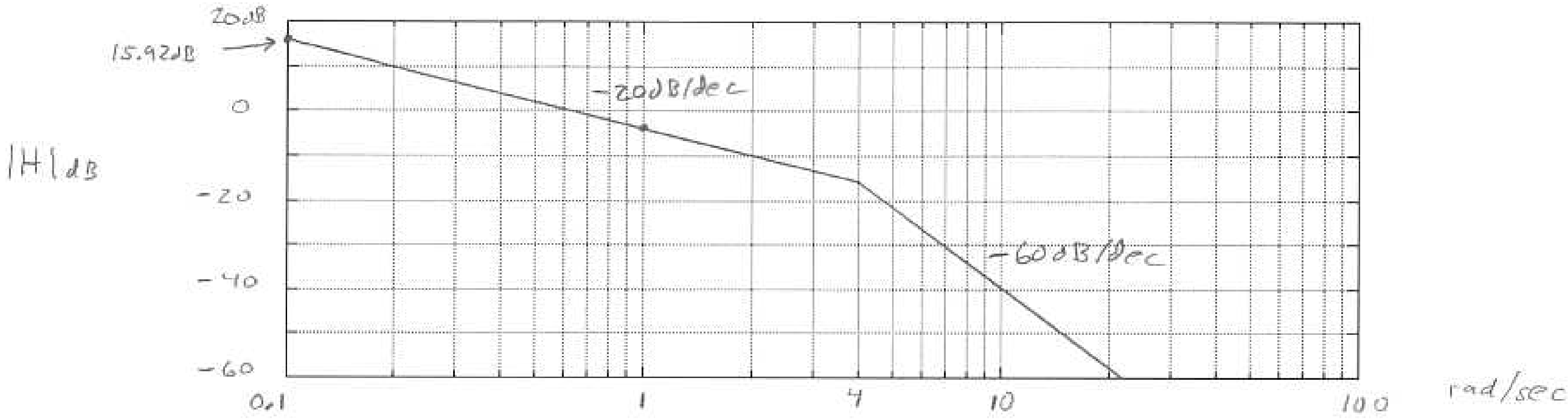
Initial Phase: $90°(0-1) = -90°$ Final Phase: $90°(0-3) = -270°$

Magnitude

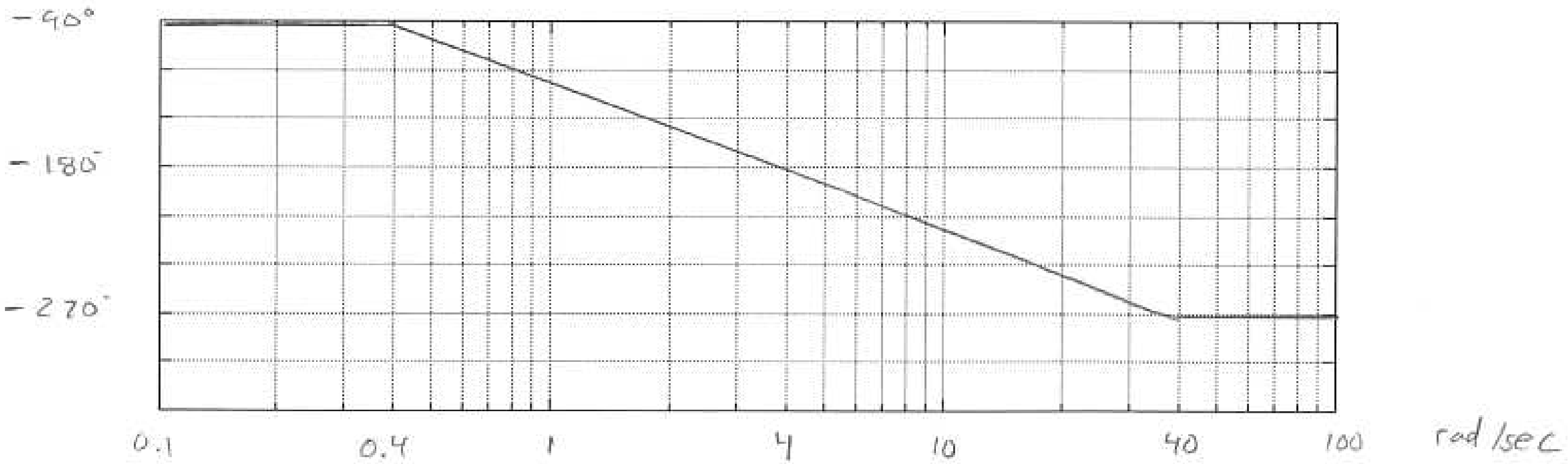
ω	Δ slope	net slope
low	—	−20dB/dec
4	−40dB/dec	−60dB/dec

Phase

ω		Δ slope	net slope
low		—	0°/dec
0.4	+p	−90°/dec	−90°/dec
40	−p	+90°/dec	0°/dec



20dB
15.92dB
0
|H|dB
-20
-40
-60
-20dB/dec
-60dB/dec
0.1
1
4
10
100
rad/sec



-90°
-180°
-270°
0.1
0.4
1
4
10
40
100
rad/sec

Chapter 14, Solution 22.

$$20 = 20\log_{10} k \longrightarrow k = 10$$

A zero of slope $+20$ dB/dec at $\omega = 2 \longrightarrow 1 + j\omega/2$

A pole of slope -20 dB/dec at $\omega = 20 \longrightarrow \dfrac{1}{1 + j\omega/20}$

A pole of slope -20 dB/dec at $\omega = 100 \longrightarrow \dfrac{1}{1 + j\omega/100}$

Hence,

$$\mathbf{H}(\omega) = \frac{10(1 + j\omega/2)}{(1 + j\omega/20)(1 + j\omega/100)}$$

$$\mathbf{H}(\omega) = \underline{\frac{\mathbf{10^4\,(2 + j\omega)}}{\mathbf{(20 + j\omega)(100 + j\omega)}}}$$

$$\underline{H(s) = \frac{10^4(s+2)}{(s+20)(s+100)}}$$

Chapter 14, Solution 24.

Curve is misdrawn, it should start at 40dB and come down to 20dB (not 0dB as shown)

$$40 = 20\log_{10} K \longrightarrow K = 100$$

There is a pole at ω=50 giving $1/(1+j\omega/50)$

There is a zero at ω=500 giving $(1 + j\omega/500)$.

There is another pole at ω=2122 giving $1/(1 + j\omega/2122)$.

Thus,

$$H(\omega) = \frac{100(1 + j\omega/500)}{(1 + j\omega/50)(1 + j\omega/2122)} = \frac{100x\dfrac{1}{500}(s+500)}{\dfrac{1}{50}x\dfrac{1}{2122}(s+50)(s+2122)}$$

or

$$H(s) = \frac{21,220(s+500)}{(s+50)(s+2122)}$$