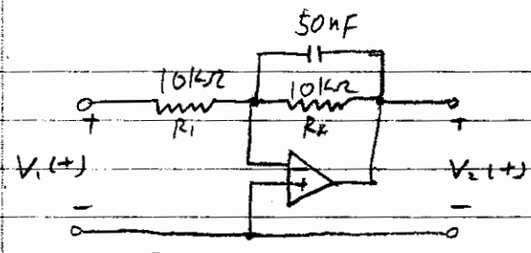
[redacted]

B5

12-4, 15, 21, 31,

12-4

10



$C = 50nF$

$R_1 = R_2 = 10k\Omega$

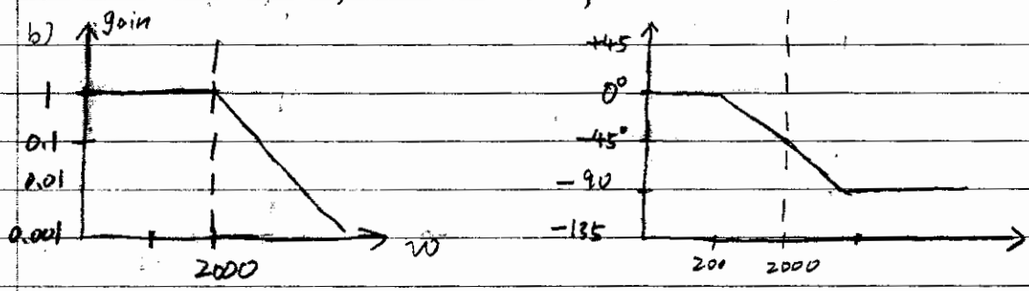
$Z_2 = \frac{R_2 \cdot \frac{1}{sC}}{R_2 + \frac{1}{sC}} = \frac{R_2}{R_2sC+1}$ $\quad Z_1 = R_1$ $\quad T_V(s) = -\frac{R_2}{R_2sC+1} \cdot \frac{1}{R_1} = -\frac{1}{R_2sC+1}$

$= -\frac{\frac{1}{R_2C}}{s+\frac{1}{R_2C}}$

$\Rightarrow T_V(s) = -\frac{2000}{s+2000}$

a) $|T_V(0)| = 1$, $|T_V(\infty)| = 0$; $\omega_c = 2000$, Low-Pass

b)



c) $T_V(s) = -\frac{R_2}{(R_2sC+1)R_1} \Rightarrow T_V(s)|_{s=0} = -\frac{R_2}{R_1}$

To double passband gain, either have $R_2 \times 2$ or $R_1/2$

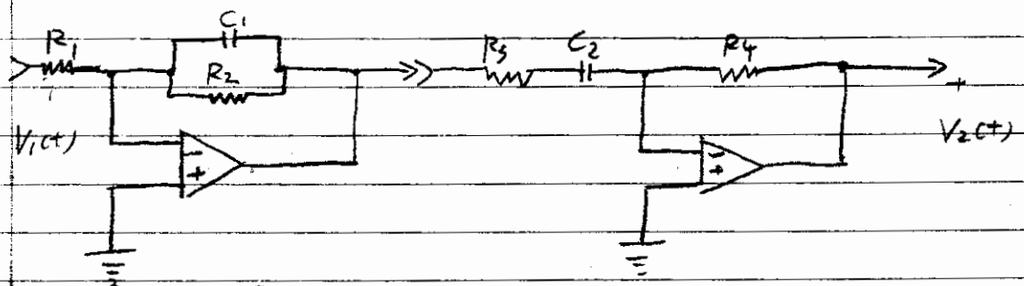
$\Rightarrow T_V(s) = -\frac{R_2/R_1}{\frac{s}{(\frac{1}{R_2C})}+1}$

R_2 cannot change b/c it changes ω_c

$\Rightarrow$ So change R_1 to $R_1/2 = 10k\Omega/2 = 5k\Omega$

12-15

10



$\Rightarrow C_1 // R_2 = \frac{R_2}{R_2sC_1+1} \Rightarrow T_{V_1} = -\frac{R_2}{(R_2sC_1+1)R_1} = -\frac{R_2/R_1}{\frac{s}{\frac{1}{R_2C_1}}+1}$

$\rightarrow$

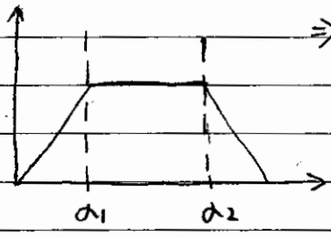
Select elements values so $K=10$, $\omega_c = 100$ & 2500 rad/s

$R \geq 10k\Omega$ $\quad C \leq 1\,\mu F$

$$T_{V_2}(s) = \frac{-R_4}{R_3 + \frac{1}{sC_2}} = \frac{-R_4 C_2 s}{R_3 C_2 s + 1}$$

$$T_V(s) = \left[\frac{R_2}{(R_2 s C_1 + 1) R_1}\right] \cdot \left[\frac{R_4 C_2 s}{R_3 C_2 s + 1}\right]$$

Low pass: $\omega_c = \frac{1}{R_2 C_1}$ $\qquad$ High pass: $\omega_c = \frac{1}{R_3 C_2}$



$$\Rightarrow \text{Gain} = \left[\frac{R_2}{R_1} \cdot \frac{R_4}{R_3}\right] = \frac{R_2 R_4}{R_1 R_3} = 10$$

$$\Rightarrow \frac{1}{R_2 C_1} = 2500 \text{ rad/s} \quad \& \quad \frac{1}{R_3 C_2} = 100 \text{ rad/s}$$

Let $C_1 = 1nF$, $C_2 = 20nF$

$\Rightarrow R_2 = 400k\Omega$ $\qquad R_3 = 500k\Omega$

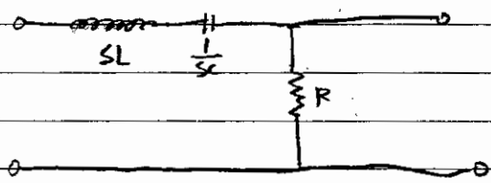
$$\Rightarrow \text{Gain} = \frac{400k \cdot R_4}{500k \cdot R_1} = 10 \Rightarrow \frac{4R_4}{5R_1} = 10 \Rightarrow \frac{R_4}{R_1} = \frac{25}{2} = \frac{250}{20}$$

So $R_4 = 250k\Omega$, $R_1 = 20k\Omega$, $R_3 = 500k\Omega$, $R_2 = 400k\Omega$

$C_1 = 1nF$, $C_2 = 20nF$

12-21. $R = 24$ bandwidth $= 4M$ rad/s, $\omega_0 = 40M$ rad/s $\quad L, C, Q = ?$ $\quad \omega_{c_1}, \omega_{c_2} = ?$

10



$$\Rightarrow 4\times10^6 = 24/L \Rightarrow \boxed{L = 6\mu F}$$

$$\Rightarrow \omega_0^2 = \frac{1}{LC} \Rightarrow C = \frac{1}{L\omega_0^2} \approx \boxed{104\,pF}$$

$$\Rightarrow Q = \omega_0/\beta = \frac{40\times10^6}{4\times10^6} = \boxed{10}$$

$\omega_{c1} = 30.05\ M$

$\omega_{c2} = 42.05\ M$

11-21 continued

$$\begin{cases} 4M = \omega_{c2} - \omega_{c1} \\ 40M = \sqrt{\omega_{c1}\cdot\omega_{c2}} \end{cases} \Rightarrow \begin{cases} 4M = \omega_{c2} - \omega_{c1} \\ (40M)^2 = \omega_{c1}\cdot\omega_{c2} \end{cases}$$

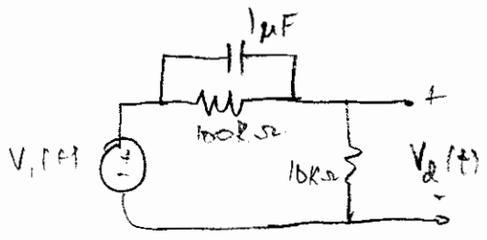
$\Rightarrow \omega_{c2} = 4M + \omega_{c1} \Rightarrow (40M)^2 = \omega_{c1}\cdot 4M + \omega_{c1}^2$

$\omega_{c1} = 38.05\ M\ rad/s$

$4M = \omega_{c2} - 38.05M \Rightarrow \omega_{c1} = 42.05\ M\ rad/s$

31.

10



$$T(s) = \frac{10000}{10000 + \left(\frac{\frac{1}{10^{-5}s}\cdot 10^5}{\frac{1}{10^{-5}s} + 10^5}\right)} = \frac{10^4}{10^4 + \frac{10^{10}}{10^5 + 10^5 s}}$$

$$= \frac{10^{10} + 10^9 s}{11\times 10^{10} + 10^9 s} = \frac{s+10}{s+110}$$

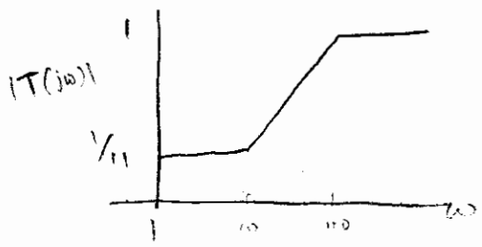
$z_1 = -10$

$p_1 = -110$

$$T(j\omega) = \frac{1}{11}\left(\frac{1 + j\omega/10}{1 + j\omega/110}\right) \qquad k_0 = \frac{1}{11} \qquad |T(j\omega)|_{sc} = \frac{1/11\ (\omega/10)}{\omega/110} = 1$$

$$|T(j\omega)| = \begin{cases} 1/11 & 0 < \omega < 10 \\ \omega/110 & 10 < \omega < 110 \\ 1 & \omega > 110 \end{cases}$$

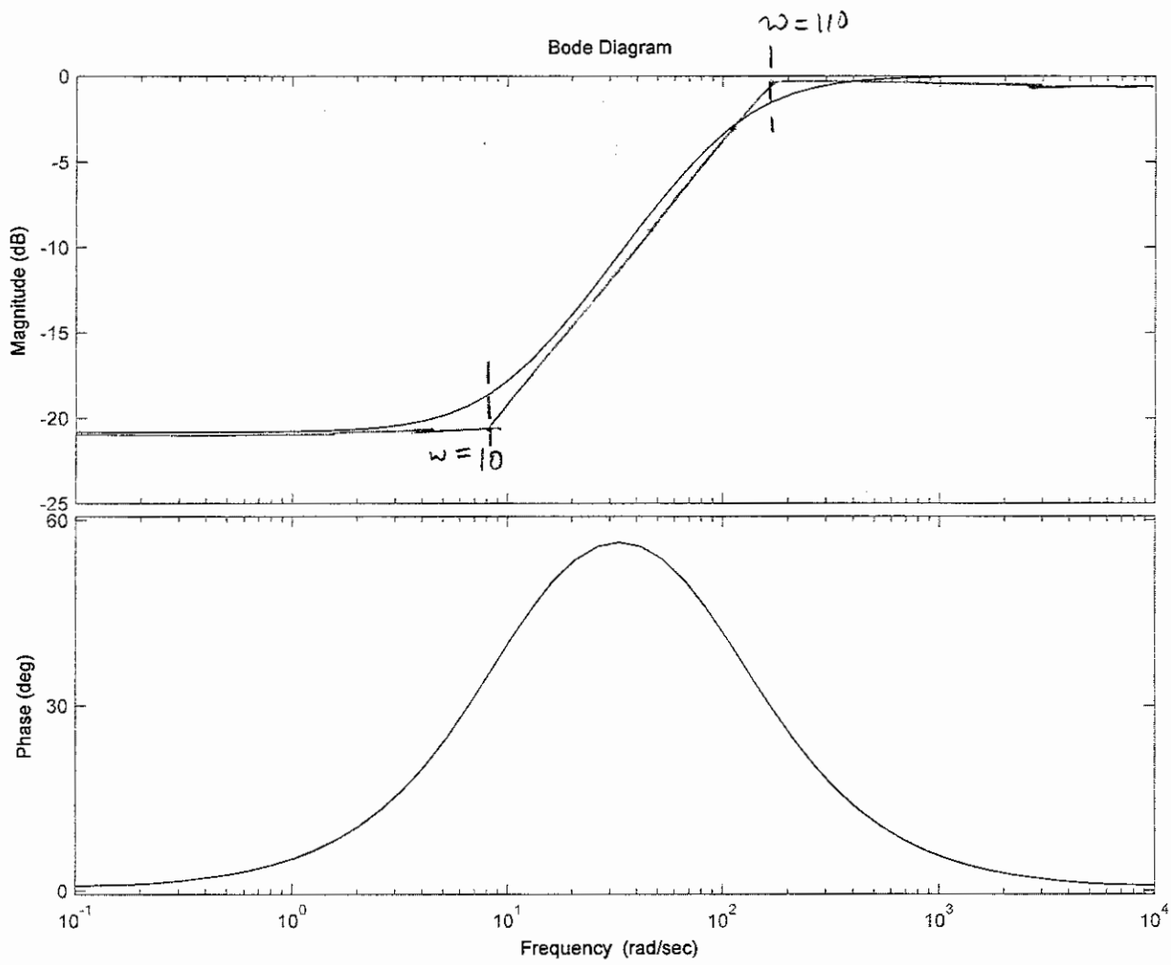
$\omega_c = 10\ (z_1),\ 110\ (p_1)$



$V_1 = 10 \sin 30t$

$A_{sc} = \frac{30}{110} = .273V$

$A_{act} = 1/11\ \left(\frac{1 + j\cdot 3\%}{\quad}\right) = .2736V$


Bode Diagram
ω = 110
ω = 10
Magnitude (dB)
0
-5
-10
-15
-20
-25
Phase (deg)
60
30
0
10^-1
10^0
10^1
10^2
10^3
10^4
Frequency (rad/sec)