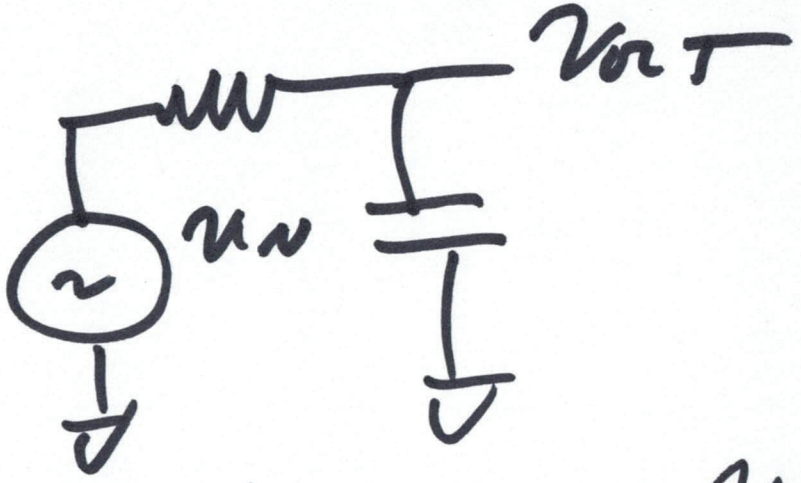
EE 221 Circuits II

March 1, 2023

Lecture 12



$$v_{out} = v_{in} \cdot \frac{\frac{1}{j\omega C}}{\frac{1}{j\omega C} + R}$$

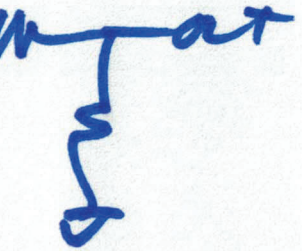
$$\frac{v_{out}}{v_{in}} = \frac{1}{1 + j\omega RC}$$

$$\frac{1}{1 + j\left(\frac{f}{f_{3dB}}\right)}$$

pole

$$f_{3dB} = \frac{1}{2\pi RC}$$

$$\left|\frac{1}{1+j\left(\frac{f}{f_{3dB}}\right)}\right| = \frac{1}{\sqrt{1+\left(\frac{f}{f_{3dB}}\right)^2}}$$



2dec

12.3 ← 1.23 KHz → 12.3 KHz ÷10

0.1 f3dB f3dB 10 f3dB

0dB = 1

0

-45

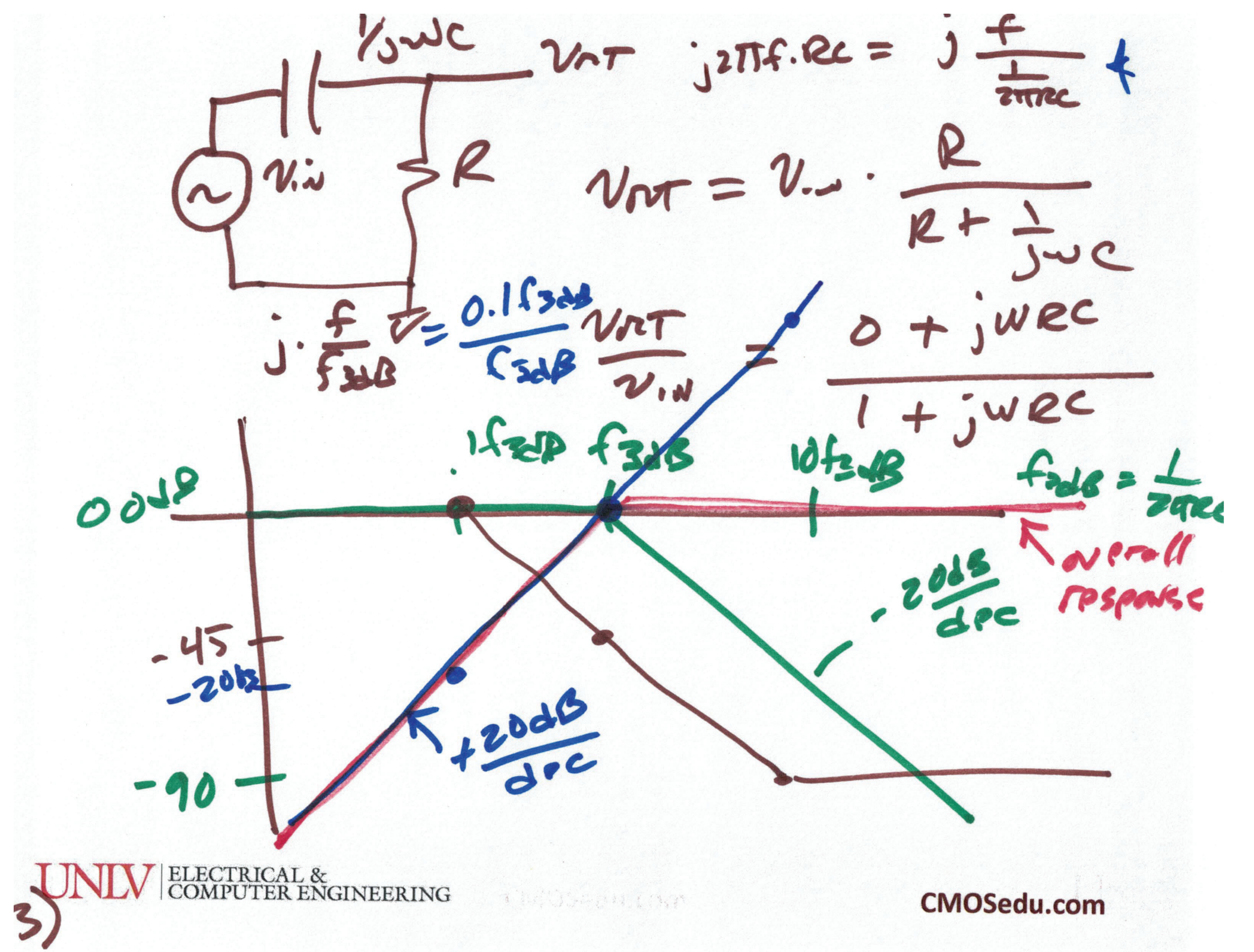
-90

-20 dB/dec

Bode

$$\angle\frac{1}{1+j\frac{f}{f_{3dB}}} \Rightarrow -\tan^{-1}\frac{f}{f_{3dB}}$$

2)



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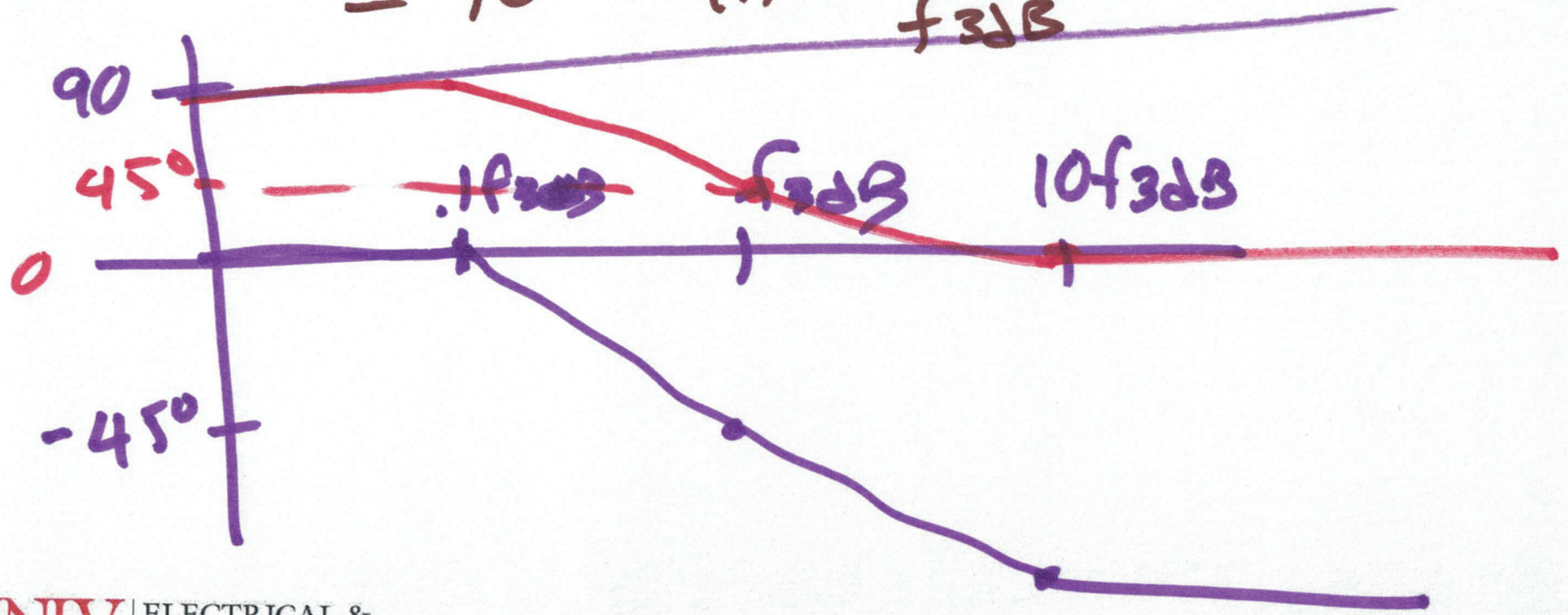
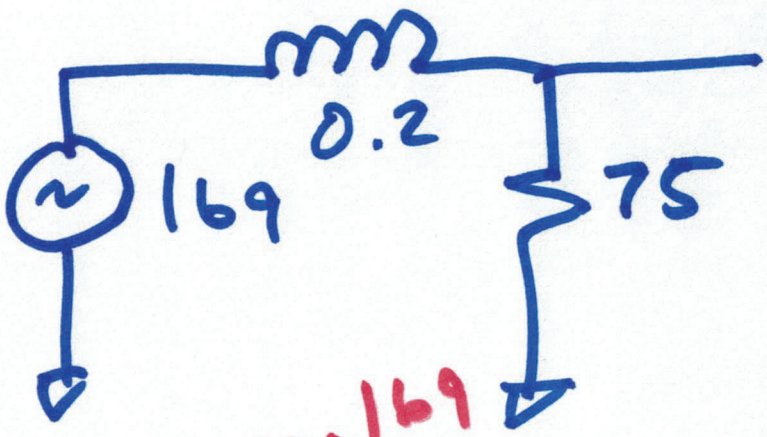
$$\frac{V_{out}}{V_{in}} = \frac{0 + j\omega RC}{1 + j\omega RC} = \frac{0 + j\frac{f}{f_{3dB}}}{1 + j\frac{f}{f_{3dB}}}$$

$$\angle \frac{V_{out}}{V_{in}} = \tan^{-1}\frac{\frac{f}{f_{3dB}}}{0} - \tan^{-1}\frac{\frac{f}{f_{3dB}}}{1}$$

$$= 90 - \tan^{-1}\frac{f}{f_{3dB}}$$





$$V_{out} = \frac{169}{75} \cdot \frac{75}{75 + j\omega 0.2}$$

$$V_{out} = \frac{169}{1 + j\frac{2\pi}{75} \cdot f \cdot 0.2}$$

$$= \frac{169 + j0}{1 + j\frac{f}{59.7}}$$

$$x\,dB = 20\log 169$$

44.6 dB

48 dB

40 dB

20 dB/DEC

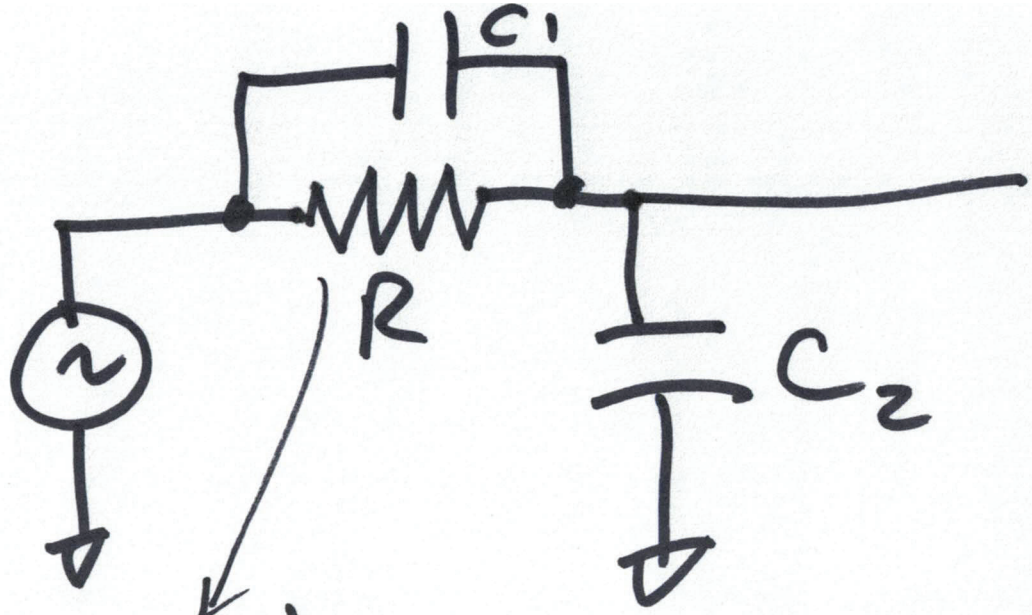
6 dB

0 dB

59.7

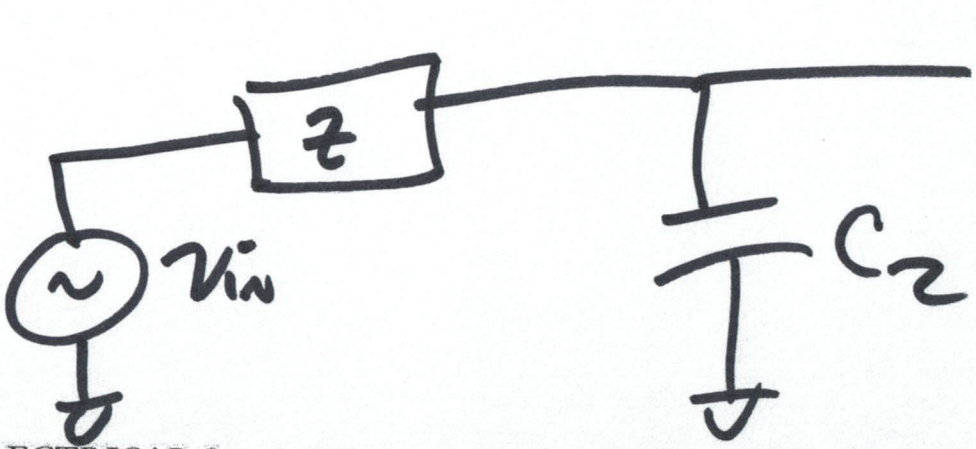
5.97 KHz

$$\angle tan^{-1}\frac{0}{169} \quad -tan^{-1}\frac{f}{59.7}$$



$$\frac{V_{OUT}}{V_{in}} = \frac{\frac{1}{jwC_2}}{\frac{1}{jwC_2} + \frac{1}{jwC_1}} = \frac{C_1}{C_1 + C_2}$$

$$\frac{R \cdot \frac{1}{jwC_1}}{R + \frac{1}{jwC_1}} = \frac{R}{1 + jwRC_1} = Z$$



$$v_{nT} = v_w \cdot \frac{\frac{1}{jwC_2}}{\frac{1}{jwC_2} + Z}$$

$$\frac{v_{nT}}{v_w} = \frac{1}{1 + jwC_2 Z}$$

$$= \frac{1}{1 + jwC_2 \cdot R \,/\!/\, \frac{1}{jwC_1}}$$

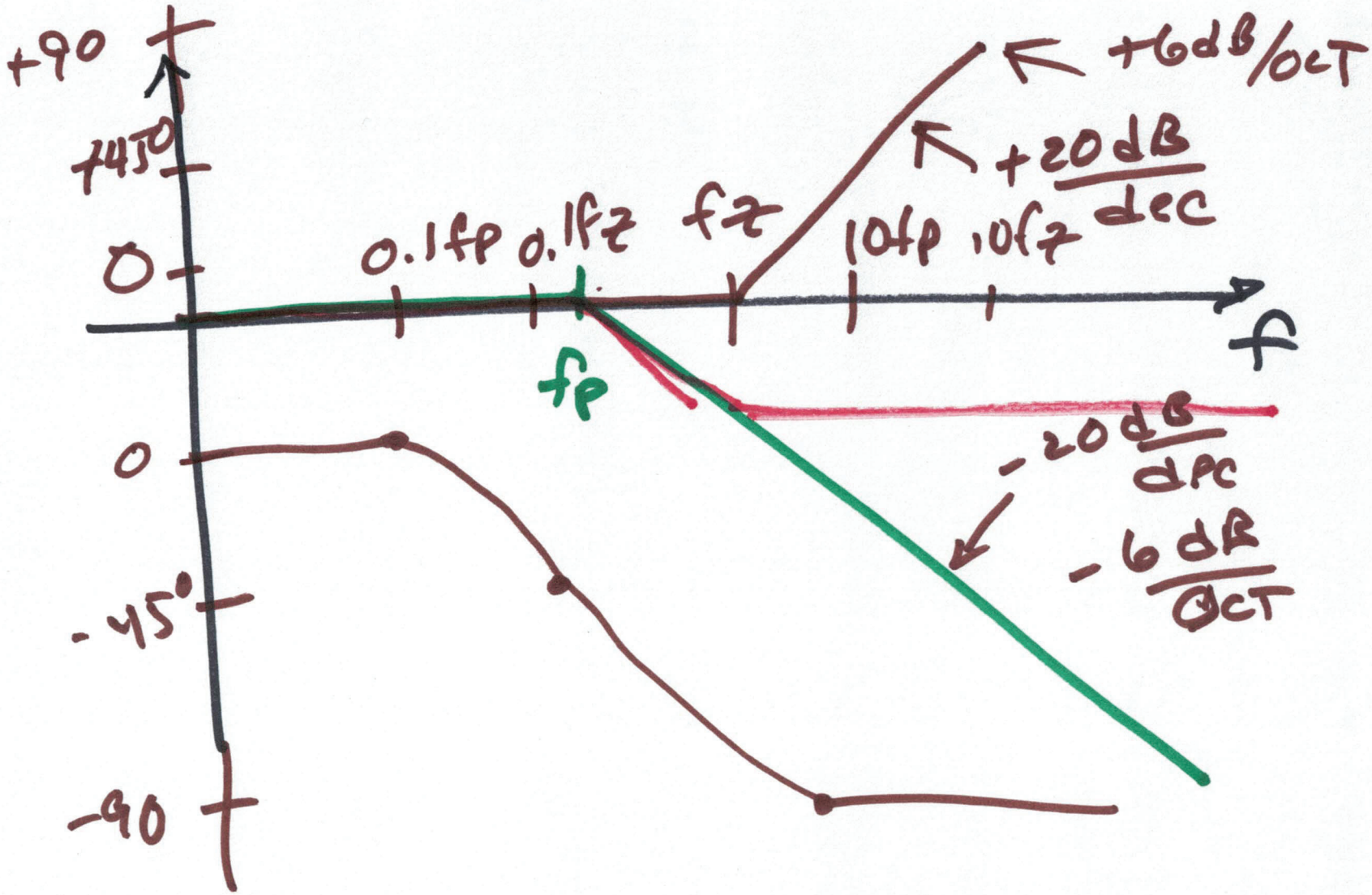
$$\frac{v_{nT}}{v_w} = \frac{1 + jwRC_1}{1 + jwRC_1 + jwC_2 R}$$

$$\frac{v_{out}}{v_{in}} = \frac{1 + j\omega RC_1}{1 + j\omega R(C_1 + C_2)}$$

$$f_z = \frac{1}{2\pi RC_1}$$

$$f_p = \frac{1}{2\pi R(C_1 + C_2)}$$

$$\frac{v_{out}}{v_{in}} = \frac{1 + j\frac{f}{f_z}}{1 + j\frac{f}{f_p}}$$


+90
+45
0
0.1fp
0.1fz
fz
10fp
10fz
+6dB/oct
+20dB/dec
f
fp
0
-20dB/dec
-6dB/oct
-45°
-90