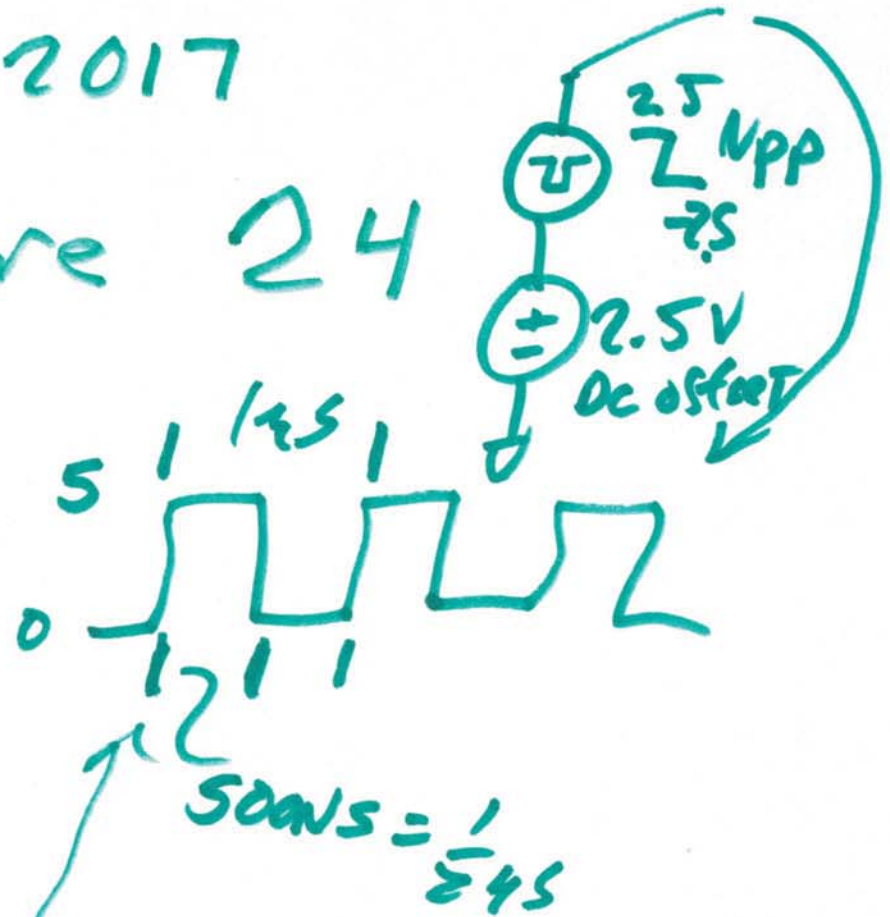
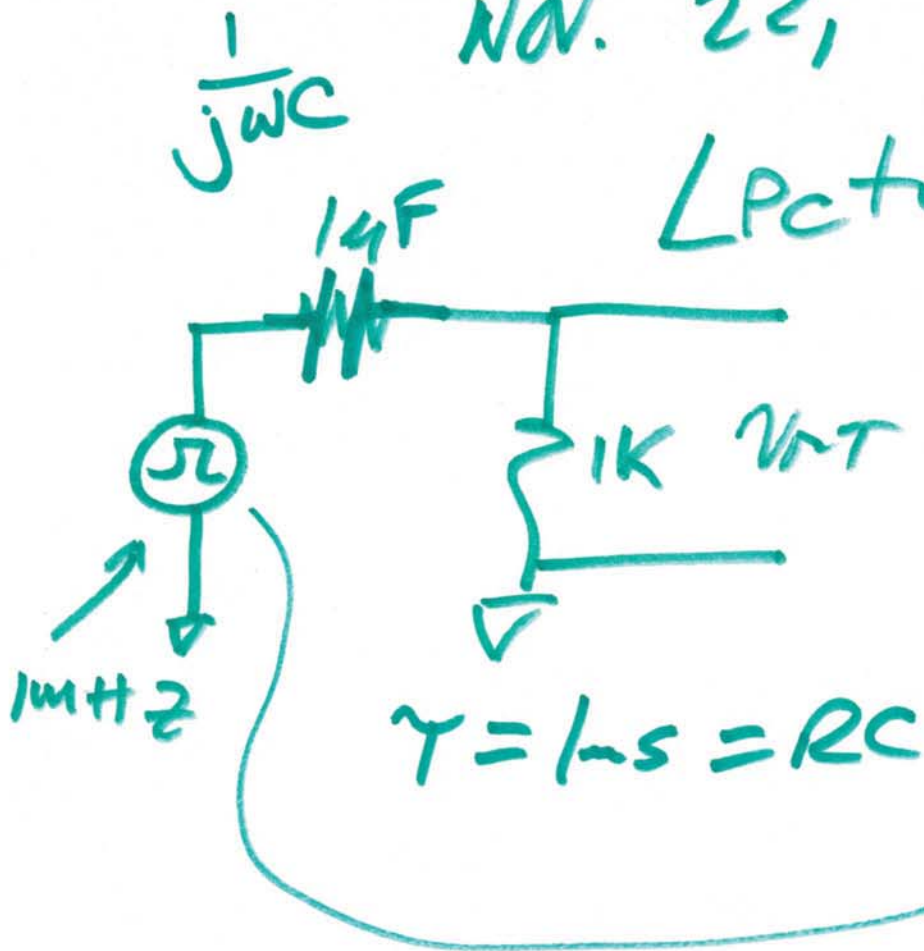


EE 220

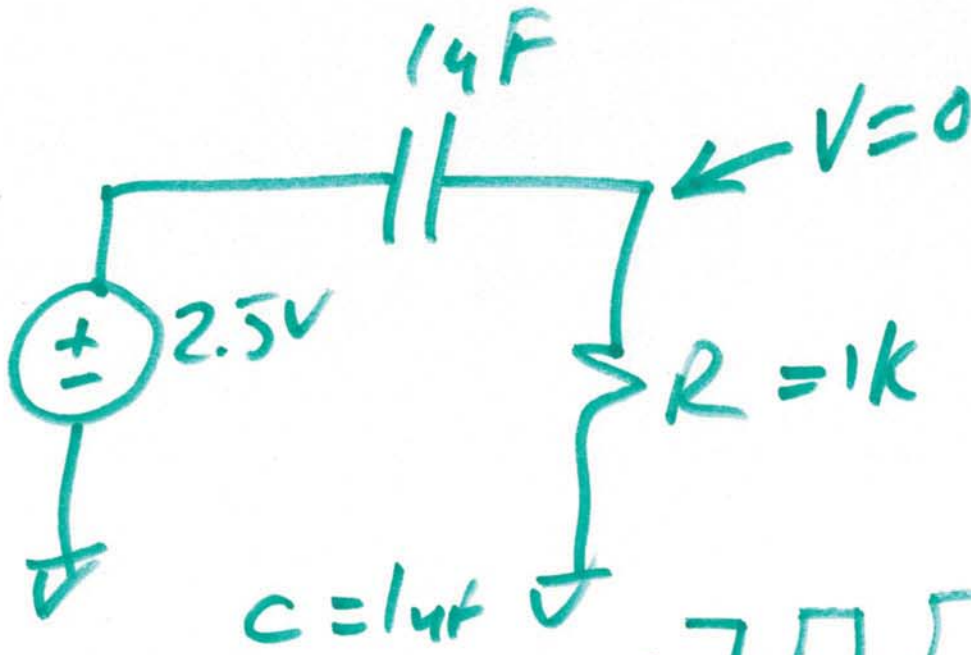
CIRCUITS 1

NOV. 22, 2017

Lecture 24

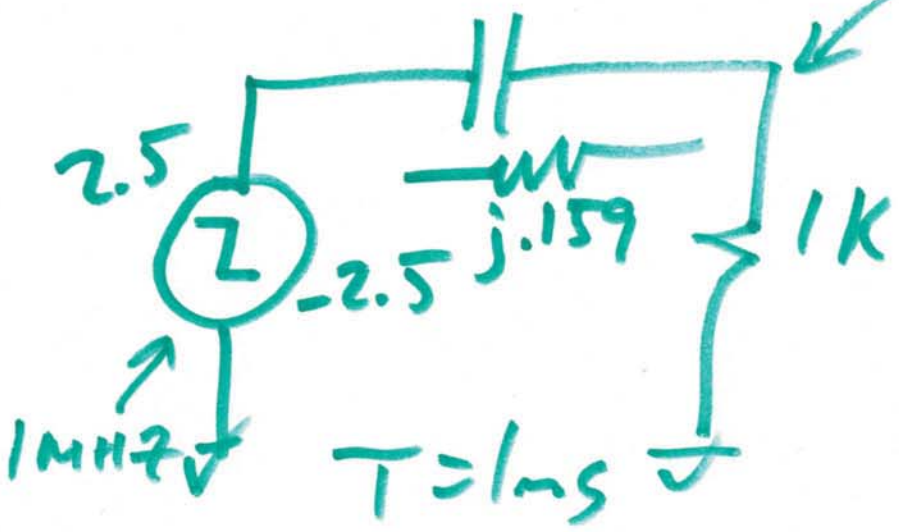
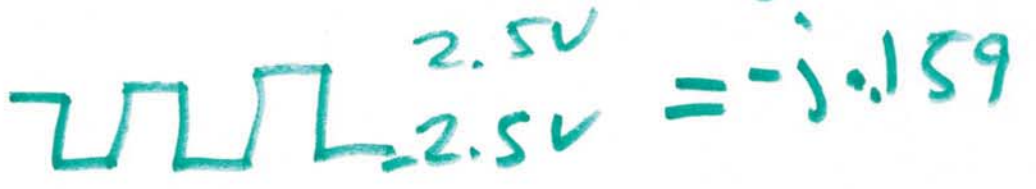


1)



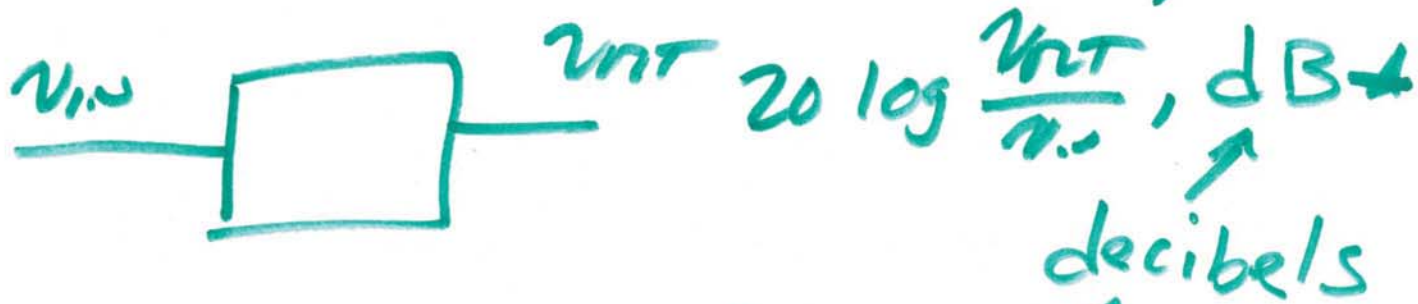
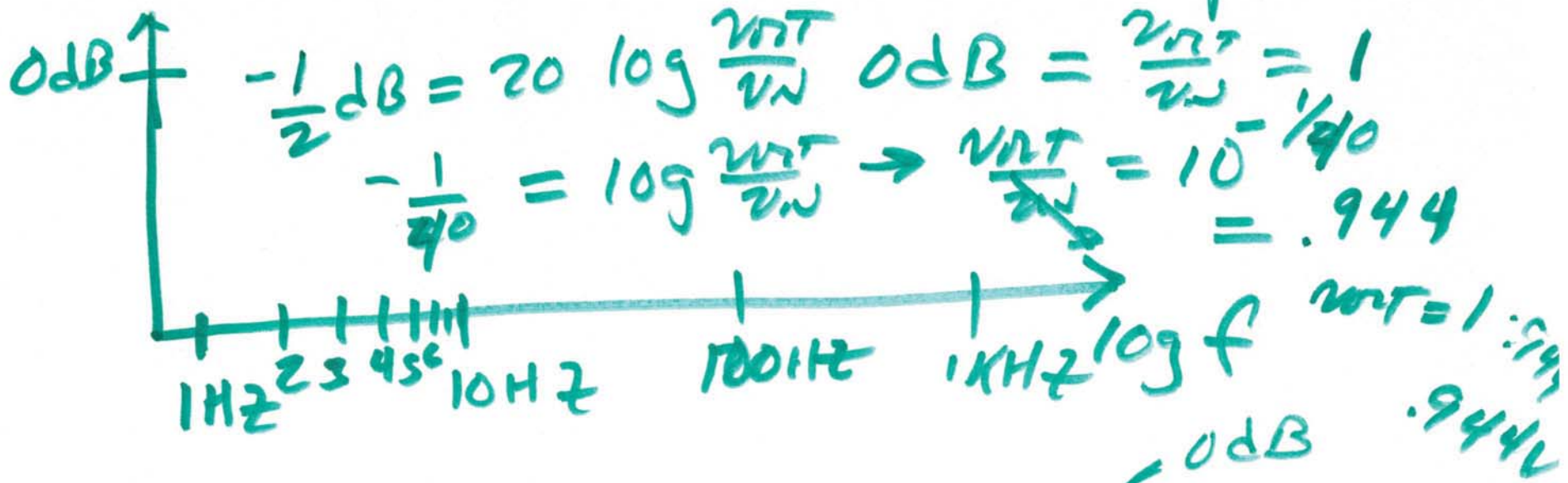
$$X_C = \frac{1}{j \cdot 2\pi \cdot 10^6 \cdot 10^{-6} \text{ MHz} \cdot \text{F}}$$

$$X_C = \frac{1}{j \cdot 6.28}$$



2)

log — display big and small things on the same plot



$10 \log \frac{P_{out}}{P_{in}}, \text{ dB}$
 $10 \log \frac{V_{out}^2/R}{V_{in}^2/R}$

3)

V_{rms}/V_{rms}

dB

1000

60 dB

$2 \Rightarrow 6 \text{ dB}$

$20 \log \frac{V_{rms}}{V_{rms}}$

100

40 dB

$\frac{1}{2} \Rightarrow -6 \text{ dB}$

$20 \log 10^2$

10

20 dB

1

0 dB

$40 \log 10$

$10^{-1} = 0.1 = \frac{1}{10}$

-20 dB

$20 \log 10^{-1}$

$0.01 = \frac{1}{100}$

-40 dB

3 dB \rightarrow

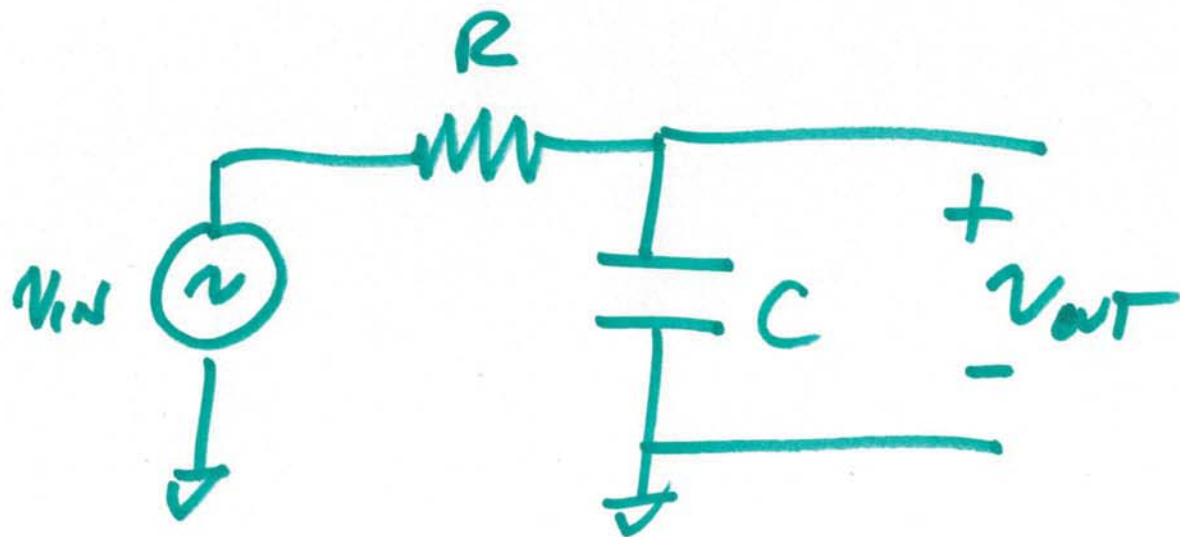
$\frac{1.414}{\sqrt{2}} = 1.414$

-3 dB \rightarrow

$\frac{1}{\sqrt{2}} = .707$



4)



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

$$\frac{V_{out}}{V_{in}} = \frac{1}{1 + j(\omega RC)}$$

transfer function

$$s = j\omega \quad \frac{1}{1 + \frac{s}{s_p}} \quad \rightarrow \quad s_p = \frac{1}{RC}$$

5)

$$\begin{aligned}
 \left| \frac{v_{out}}{v_{in}} \right| &= \frac{1}{\sqrt{1 + (2\pi f \cdot RC)^2}} \\
 \text{MAGNITUDE OF RESPONSE} & \quad f_{3dB} = \frac{1}{2\pi RC} = \frac{1}{2\pi \cdot 10^3 \cdot 10^{-6}} \\
 & \quad = 159 \text{ Hz} \\
 & \quad = \frac{1}{\sqrt{2}} \\
 & \quad = -3 \text{ dB}
 \end{aligned}$$

$$\begin{aligned}
 20 \log \frac{v_{out}}{v_{in}} &= 20 \log \left(\frac{1}{\sqrt{1 + \left(\frac{f}{f_{3dB}} \right)^2}} \right) \\
 &= -20 \log \sqrt{1 + \left(\frac{f}{f_{3dB}} \right)^2}
 \end{aligned}$$

$$\frac{v_{out}}{v_{in}} = \frac{1}{1 + j(\omega RC)} = \frac{1}{1 + j \frac{f}{f_{3dB}}}$$

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

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

