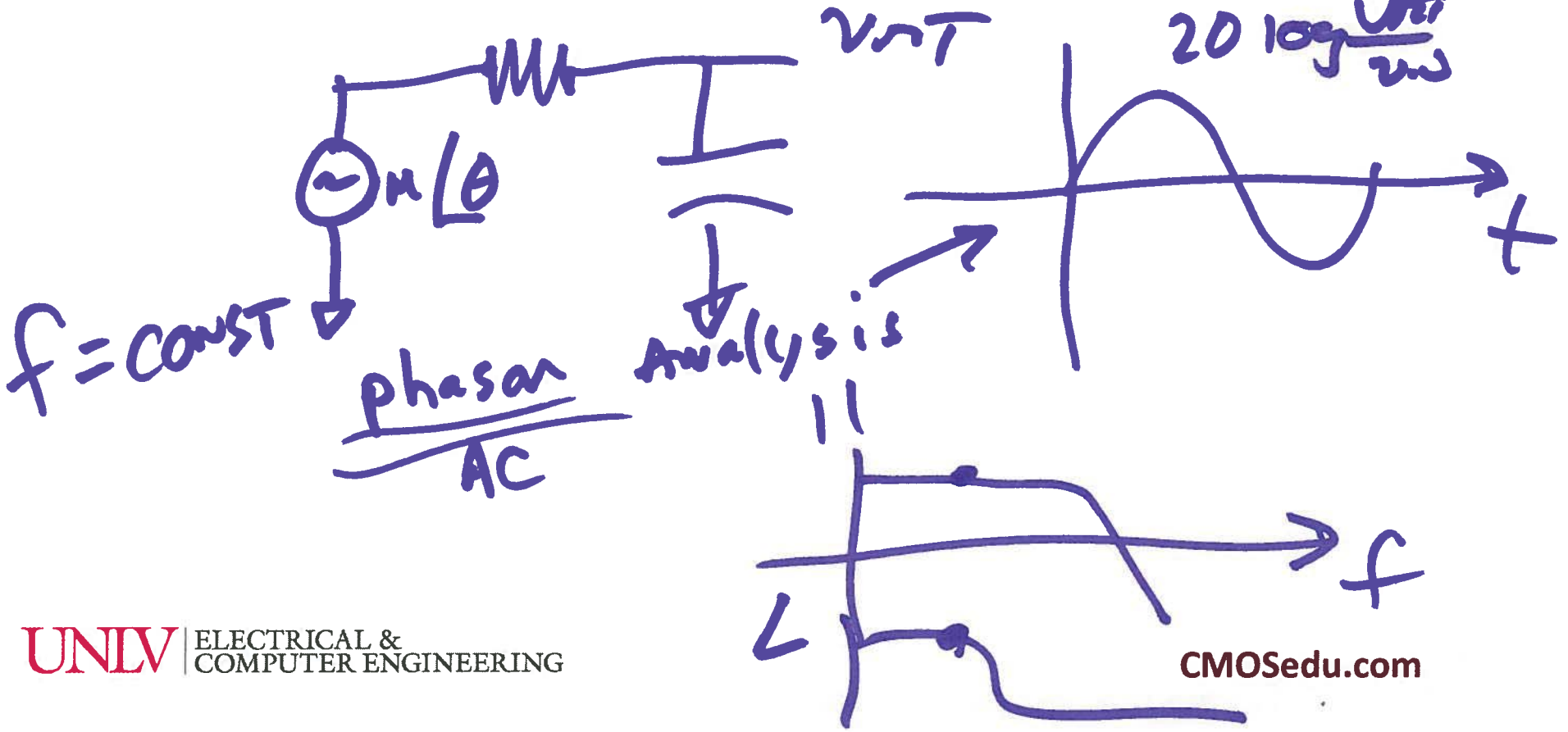
EE 220

Circuits 1

Lecture 24



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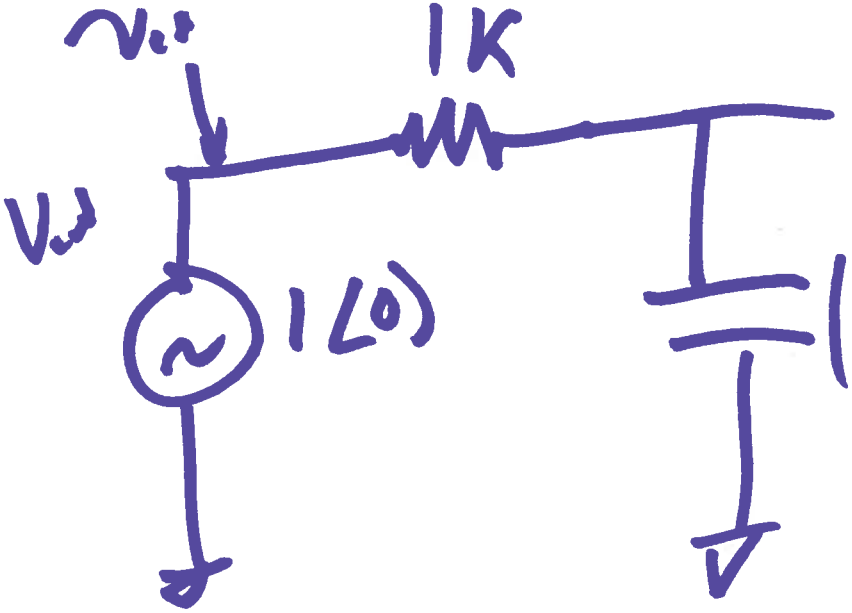
Example: Plot the magnitude & phase responses for the following CKT.



$\left|\frac{v_{out}}{v_{in}}\right| = ?$

$\angle \frac{v_{out}}{v_{in}} = ?$

$= \frac{1}{j\omega C}$

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

$$\boxed{\frac{v_{out}}{v_{in}} = \frac{1+j0}{1+j\omega RC}}$$

$$\frac{V_{out}}{V_{in}} = \frac{1 + j0}{1 + j \cdot 2\pi f \cdot RC} = \frac{\sqrt{1^2+0^2}\,\angle \tan^{-1}\frac{0}{1}}{\sqrt{1^2+(2\pi RCf)^2}\,\angle \tan^{-1} 2\pi RCf}$$

$$= \frac{1}{\sqrt{1+(2\pi RCf)^2}} \angle -\tan^{-1} 2\pi RCf$$

$f = \frac{0.1}{2\pi RC}$

$f = \frac{1}{2\pi \cdot 10^{-3}}$

$= \frac{.159}{10^{-3}}$

$= 159$ Hz

$f = \frac{1}{2\pi \cdot 10^{3} \cdot 10^{-6}}$

$$20 \log \left| \frac{v_{out}}{v_{in}} \right| = dB = \text{decibels}$$

$v_{out}/v_{in} = 100 \rightarrow 40\ dB$

Learn these

$\frac{v_{out}}{v_{in}} = 1 \Rightarrow 0\ dB$

$\frac{v_{out}}{v_{in}} = 5 \Rightarrow 14\ dB$

$\frac{v_{out}}{v_{in}} = 10 \Rightarrow 20\ dB$

$\frac{v_{out}}{v_{in}} = \frac{1}{10} \Rightarrow -20\ dB$

$\frac{v_{out}}{v_{in}} = \frac{1}{\sqrt{2}} \Rightarrow -3\ dB$

Decade → ÷10 X10

OCTave → ÷2 X2

20dB ↗ 10 (X10)

-20dB ↘ 10 (÷10)

6dB ⇒ X2

-6dB ⇒ ÷2