EE 220 Lecture 12D

July 9, 2014

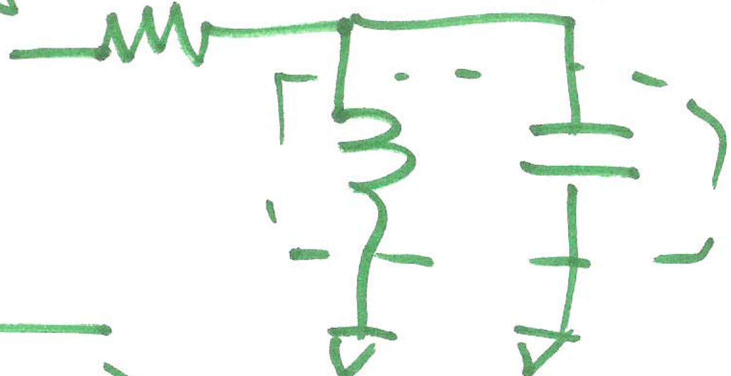
RLC circuits

$$\frac{v_{out}}{v_{in}} = \frac{s/C}{\left(s+\frac{1}{\sqrt{LC}}\right)\left(s-\frac{1}{\sqrt{LC}}\right)}$$

DC $s \to 0$

$f=\infty$ $s \to \infty$

$s = j\omega$



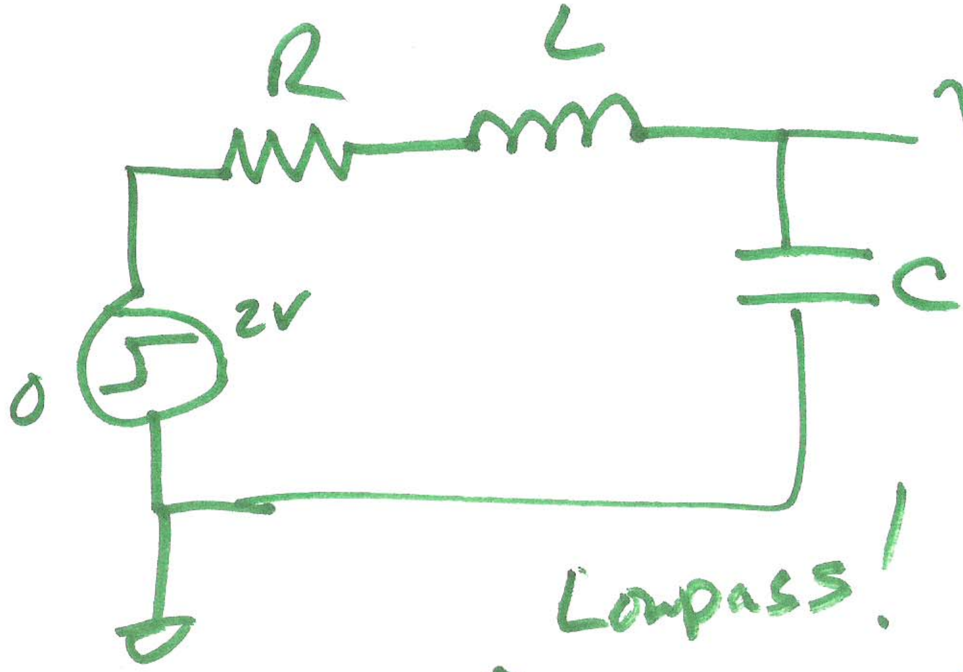
$$\frac{sL \cdot \frac{1}{sC}}{sL + \frac{1}{sC}} = \frac{s/C}{s^2 + 1/LC}$$

$$\frac{s/RC}{\left(s+\frac{1}{\sqrt{LC}}\right)\left(s-\frac{1}{\sqrt{LC}}\right)}$$

$$S_{p1} = \frac{1}{\sqrt{LC}}$$

Second-order CKT

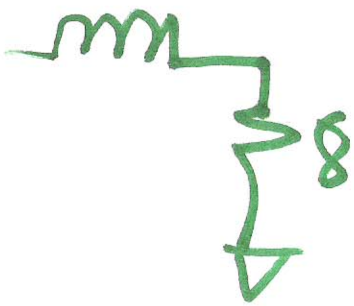
$$f_{p1} = \frac{1}{2\pi\sqrt{LC}}$$

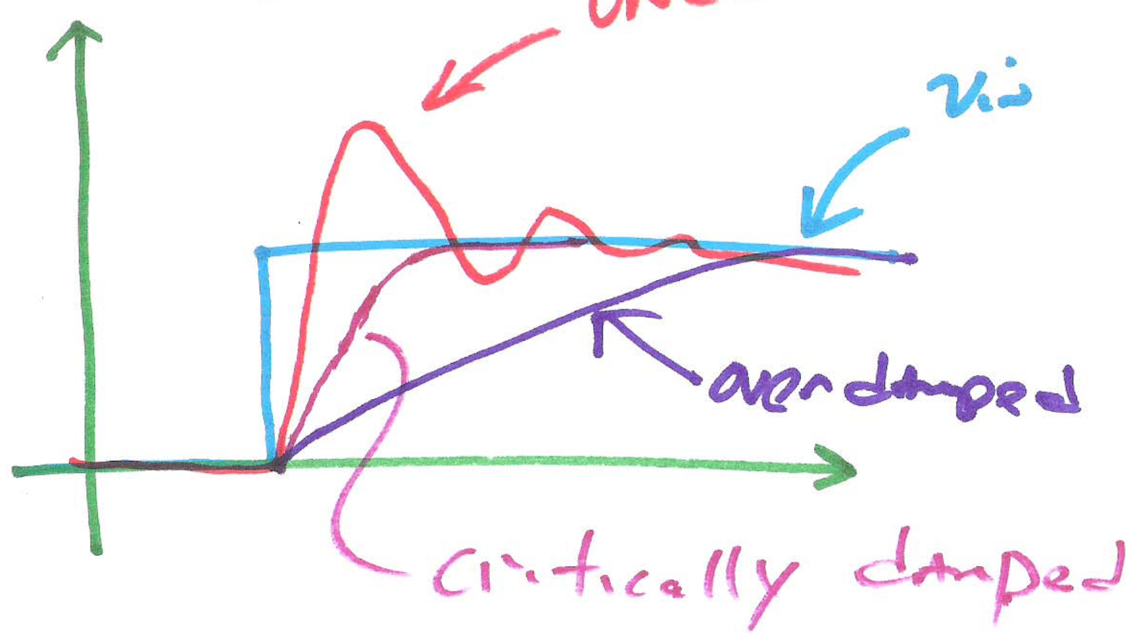


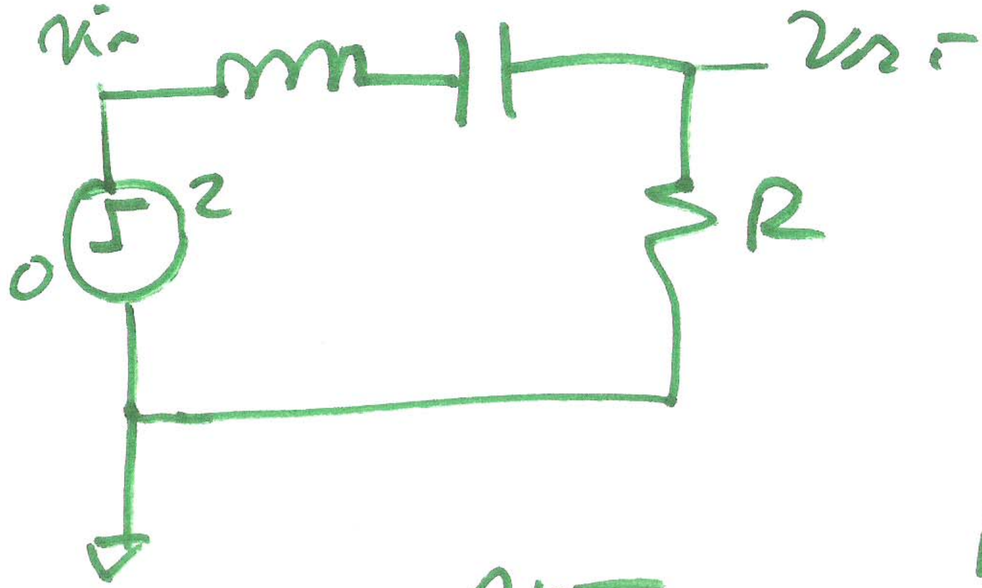
$$v_{OUT} = v_{IN} \cdot \frac{\frac{1}{sC}}{\frac{1}{sC} + Ls + R}$$

$$\frac{v_{OUT}}{v_{IN}} = \frac{1}{s^2LC + sRC + 1}$$

Lowpass!



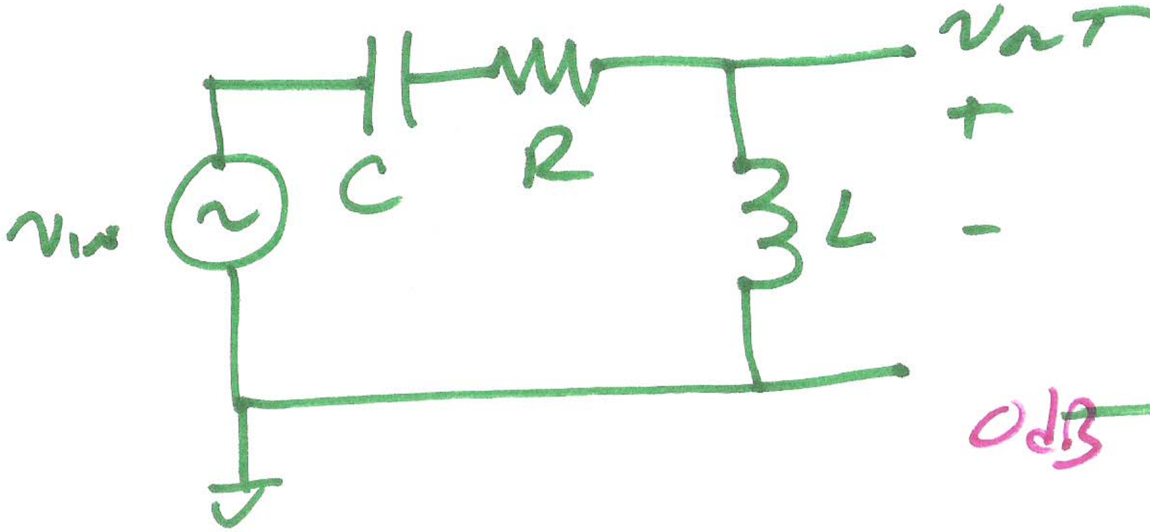


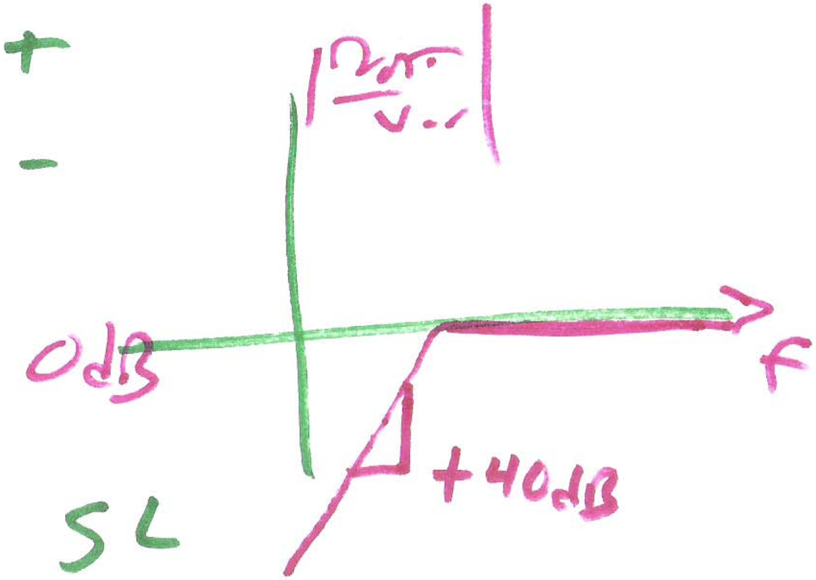


BAND pass

$$\frac{v_{out}}{v_{in}} = \frac{R}{R + sL + \frac{1}{sC}}$$

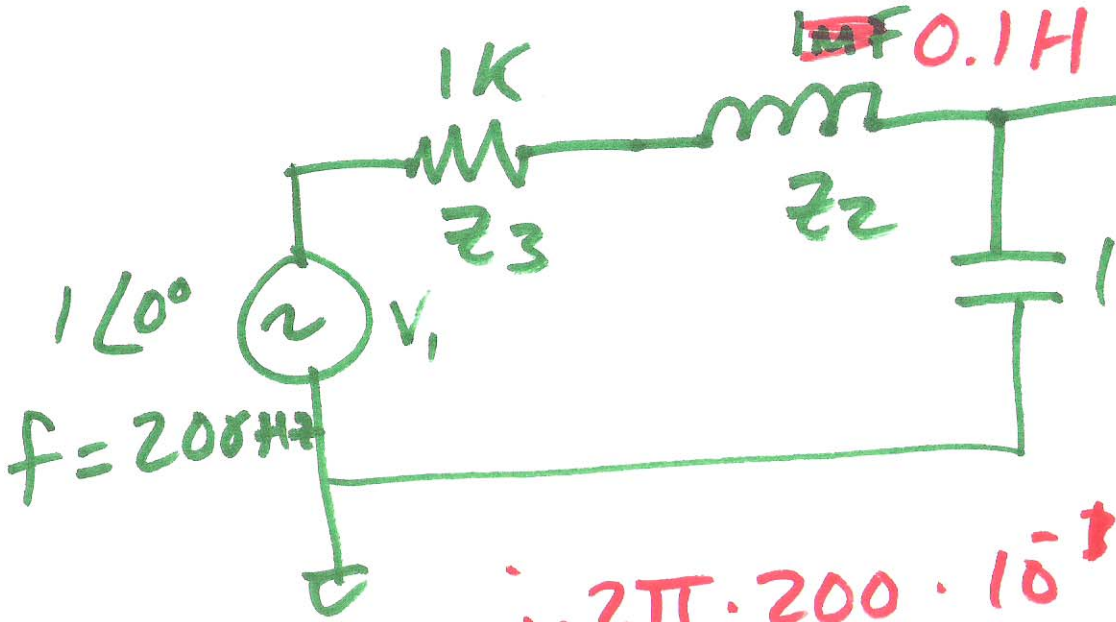
$$= \frac{sRC}{s^2LC + sRC + 1}$$





$$\frac{v_{out}}{v_{in}} = \frac{sL}{sL + \frac{1}{sC} + R}$$

$$= \frac{s^2LC}{s^2LC + sRC + 1}$$



$v_{out} = ?$

$$v_{out} = V_1 \cdot \frac{Z_1}{Z_1 + Z_2 + Z_3}$$

$$j \cdot 2\pi \cdot 200 \cdot 10^{-1} = 1.256j = 125.6j = Z_2$$

$$\frac{-j}{2\pi \cdot 200 \cdot 10^{-6}} = -796j = Z_1$$

$-j$

$180 + 90 = 270$

-90

$$\frac{v_{out}}{v_{in}} = \frac{0 + j(-796)}{j(\underbrace{-796 + 125.6}_{-670}) + 1000}$$

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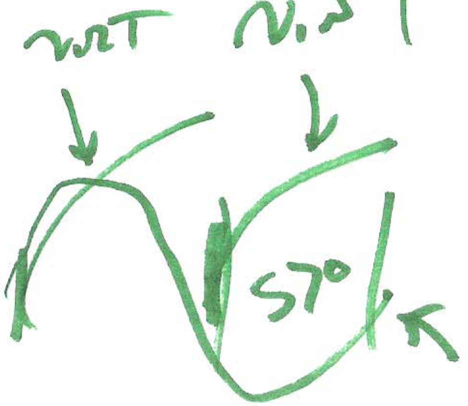
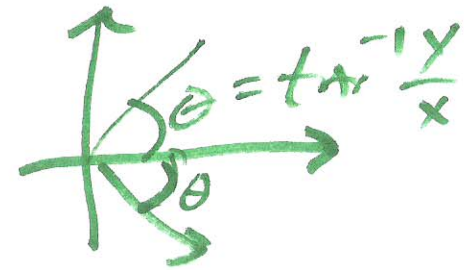
$$\left|\frac{v_{out}}{v_{in}}\right| = \frac{796}{\sqrt{10^6 + 670^2}}$$



$$= 0.66$$



$-57°$

$$\angle \frac{v_{out}}{v_{in}} = 270 + \tan^{-1}\frac{+670}{1000}$$

$$= 270 + 33.8 \quad 303.8°$$

$$\frac{t_d}{5ms} \cdot 360 = 303.8$$

$$t_d = \frac{303}{360} \cdot 5ms = \underline{\underline{4.2ms}}$$