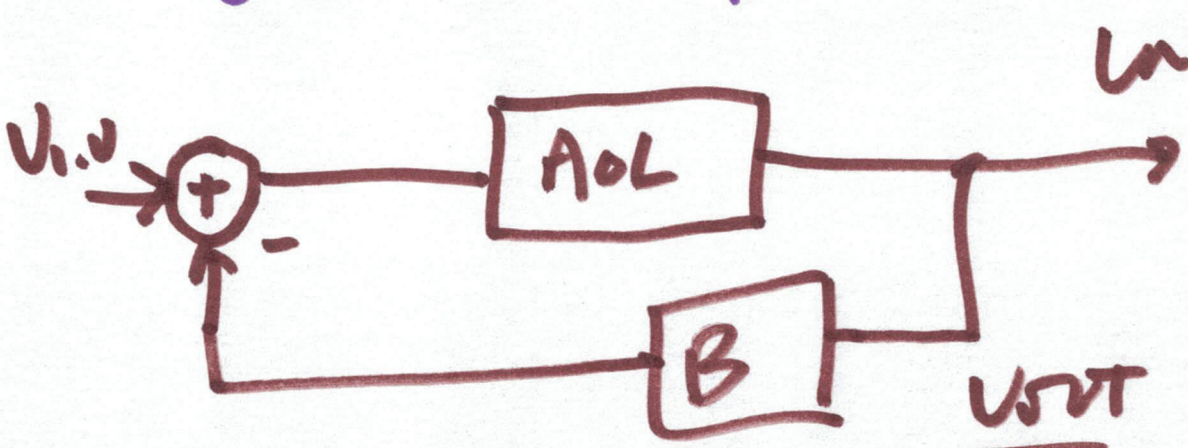
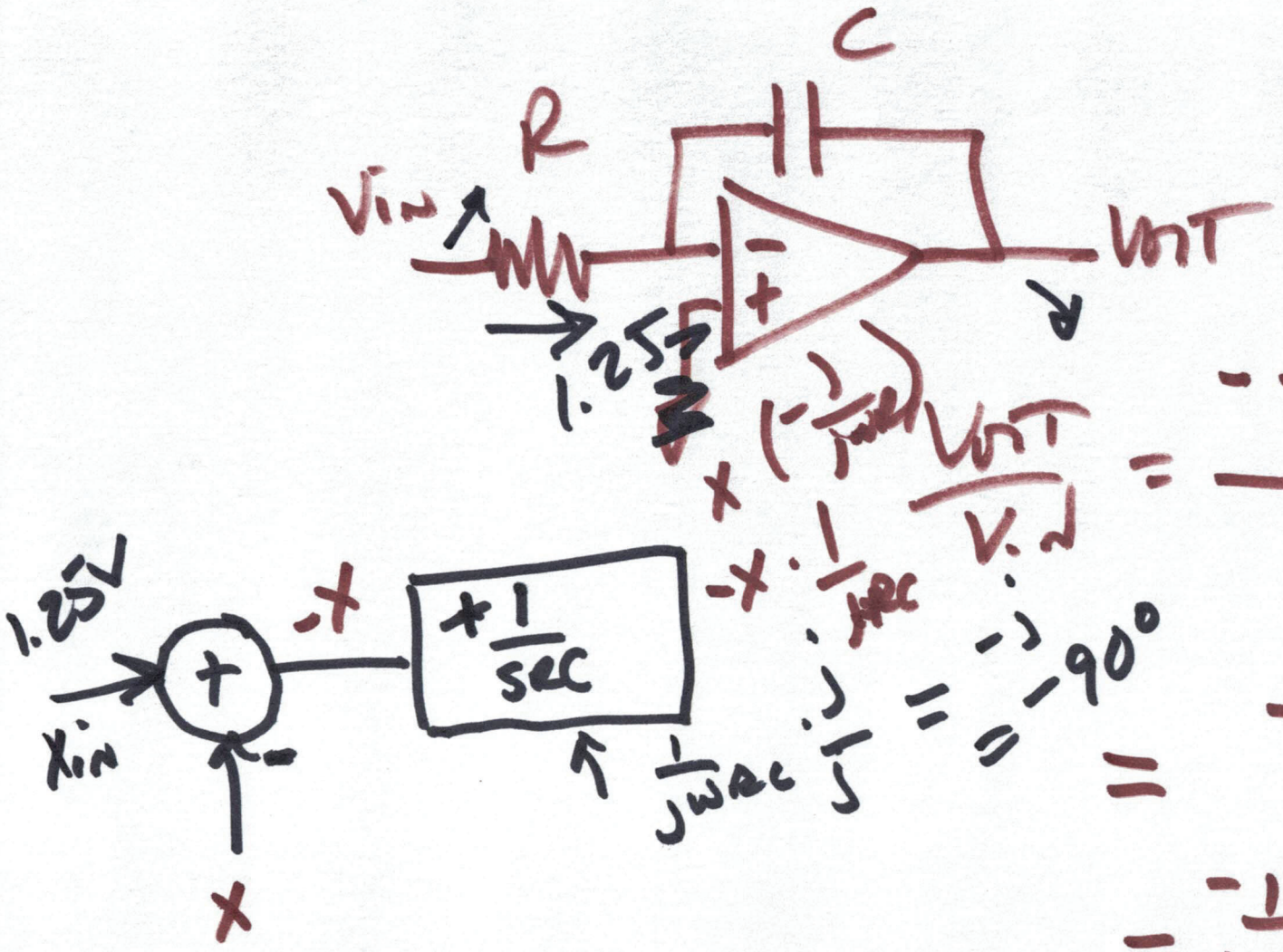
EE 442 / ECE 642
Power Electronics
Lecture 13
OCT. 17, 2022



$$\frac{V_{OUT}}{V_{IN}} = \frac{A_{OL}}{1+\beta A_{OL}}$$

$\beta A_{OL} \rightarrow -1 = 1\angle \pm 180$ LOOP gain



$$\frac{V_{out}}{V_{in}} = \frac{-\frac{1}{sC}}{R}$$

$$-x \cdot \frac{1}{sRC}$$

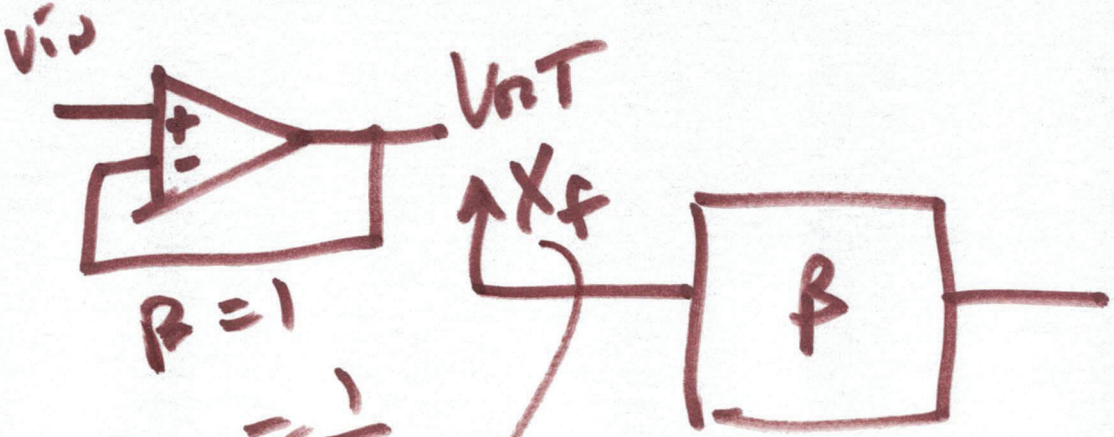
$$\frac{j}{j} = -1 = -90^\circ$$

$$= \frac{-1}{sRC}$$

$$= \frac{-1}{j\omega RC} \cdot \frac{j}{j} = \frac{j}{\omega RC}$$

$$\Rightarrow \frac{1}{\omega RC} \angle 90$$

$$A_{CL} = \frac{A_{OL}}{1 + \beta A_{OL}} \rightarrow \frac{1}{\frac{1}{A_{OL}} + \beta} = \frac{1}{\beta}$$



$\beta = 1$

$A_{CL} = \frac{1}{\beta}$

$= 1$

$A_{CL} = \frac{1}{\beta}$

$V_{OT} = 1 + \frac{R_A}{R_B}$

$1 + \frac{6}{10}$

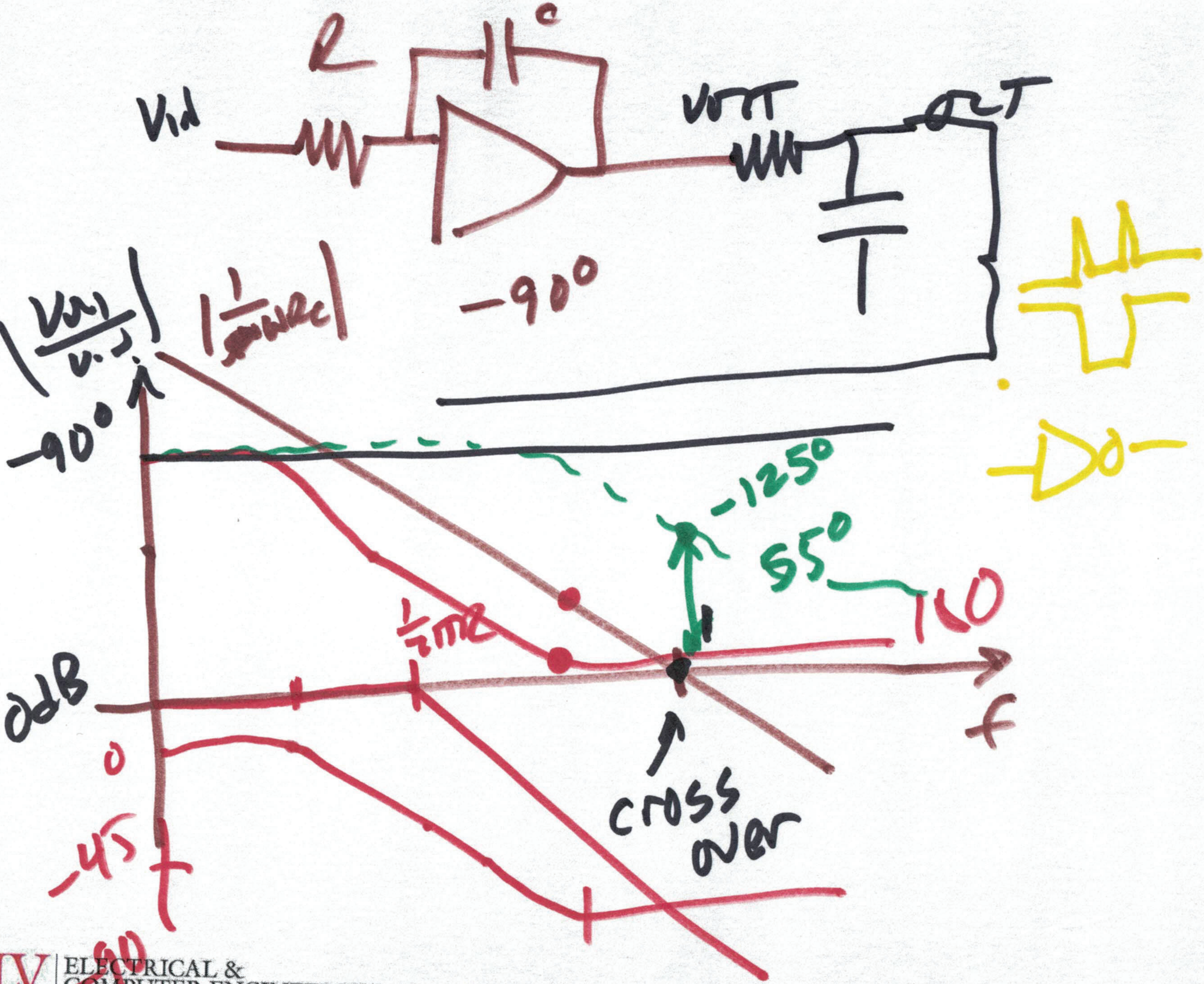
$= 1.6$

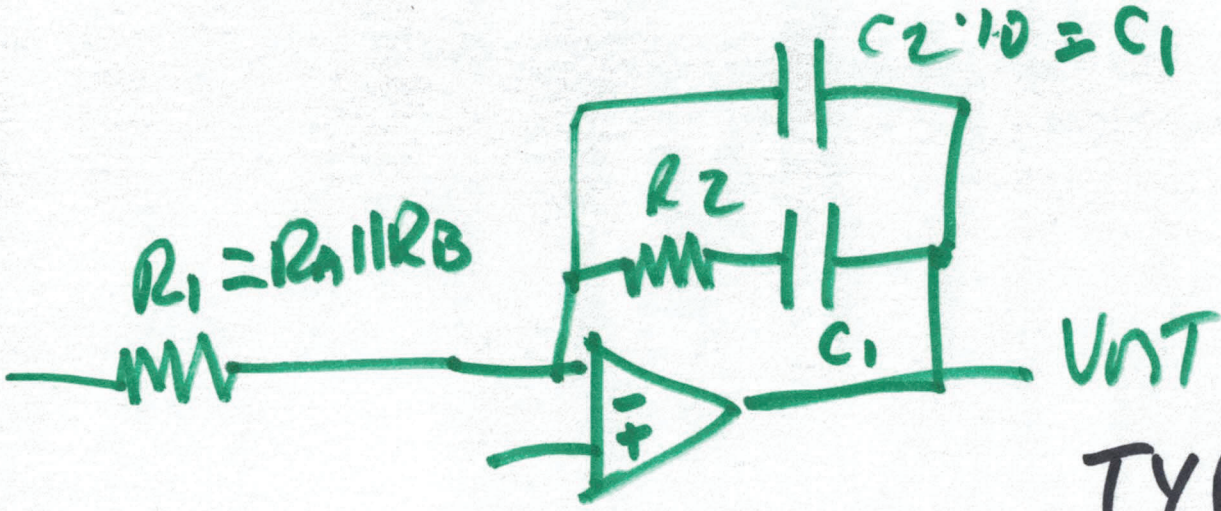
$X_f = \beta \cdot V_{OT}$

$V_{OT} \cdot \frac{R_B}{R_B + R_A}$

1.25×1.6

β





TYPE II

ACTIVE PI

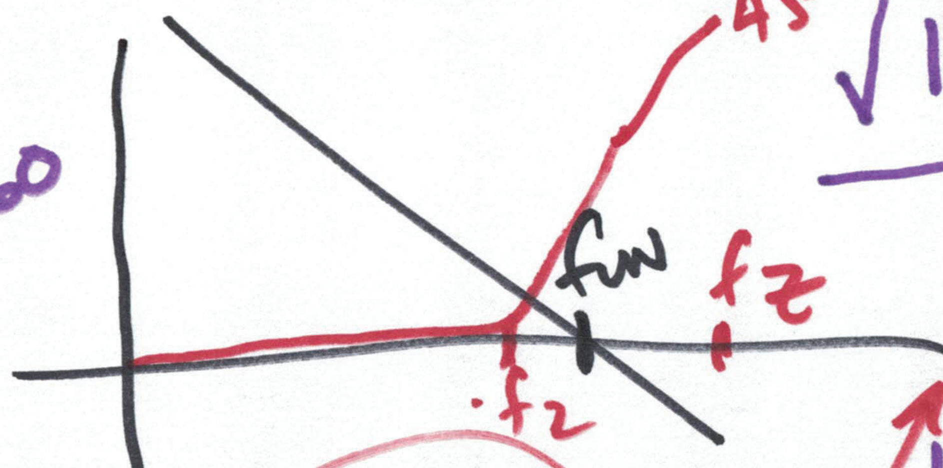
$$\frac{V_{OUT}}{V_{IN}} = -\frac{R_2 + \frac{1}{j\omega C_1}}{R_1}$$

$$= \underbrace{-\frac{R_2}{R_1}}_{\text{proportional}} + \underbrace{-\frac{1}{j\omega R_1 C_1}}_{\text{integral}}$$

$$\frac{V_{OUT}}{V_{IN}} = -\frac{1 + j\omega C_1 R_2}{j\omega R_1 C_1} = \frac{-\left(1 + j\frac{f}{f_z}\right)}{j\frac{f}{f_{un}}}$$

$$f_z = \frac{1}{2\pi C_1 R_2}, \quad f_{un} = \frac{1}{2\pi R_1 C_1}$$

$$\theta = \frac{t_d}{T} \cdot 360 = t_d \cdot f \cdot 360$$



$$\frac{\sqrt{1^2 + \left(\frac{f}{f_z}\right)^2}}{\sqrt{\left(\frac{f}{f_{un}}\right)^2}}$$

$$\tan^{-1}\frac{f/f_z}{1} - \tan^{-1}\frac{f/f_{un}}{0} \quad (\infty \rightarrow 90)$$