Power Management Integrated Circuits
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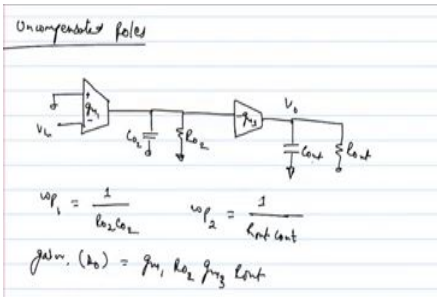
Lecture - 21
Intuitive Method of Finding the Poles, Pole Splitting after Miller Compensation

- Pole locations of a 2-stage amplifier (prior to compensation) as shown in the figure:

$$\omega_{p1} = \frac{1}{R_{o2}C_{o2}}, \qquad \omega_{p2} = \frac{1}{R_{out}C_{out}}$$

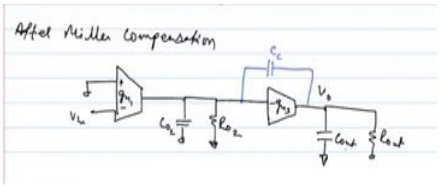
$$DC\ Gain = g_{m1}R_{o2} \cdot g_{m3}R_{out}$$



- Pole locations of a 2-stage Miller-compensated amplifier, as shown in the figure:

$$\omega_{p1} \approx \frac{1}{R_{o2}\left[C_{o2} + (1 + g_{m3}R_{out})\,C_c\right]} \approx \frac{1}{R_{o2} \cdot g_{m3}R_{out}C_c}$$

$$\omega_{p2} \approx \frac{\left(\frac{C_c}{C_c+C_{o2}}\right)g_{m3} + \frac{1}{R_{out}}}{\frac{C_cC_{o2}}{C_c+C_{o2}} + C_{out}} \approx \frac{g_{m3} + \frac{1}{R_{out}}}{C_{o2} + C_{out}} \quad for\ C_c \gg C_{o2}$$



- The pole locations after compensation can be obtained intuitively as well (refer video lecture).
- The compensated poles are farther apart (from each other) than the original uncompensated poles; this is referred to as pole splitting.
- The Miller multiplication factor along with the effect of pole splitting reduces the size of the compensating capacitor required to achieve a given phase margin.