Subject :

Assignment 5

Date:

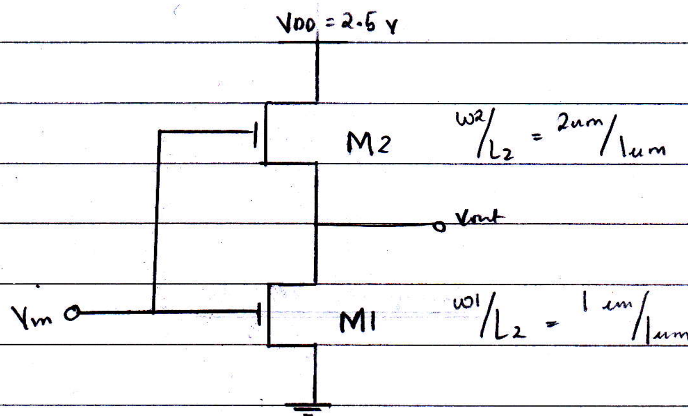
Name : Ibrahim Isa

Matric : ME131137

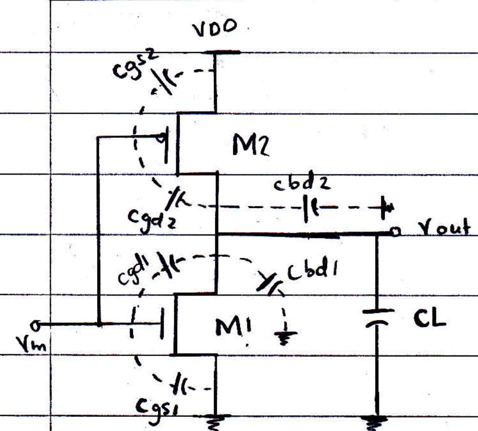
Question : For the push-pull CS amp

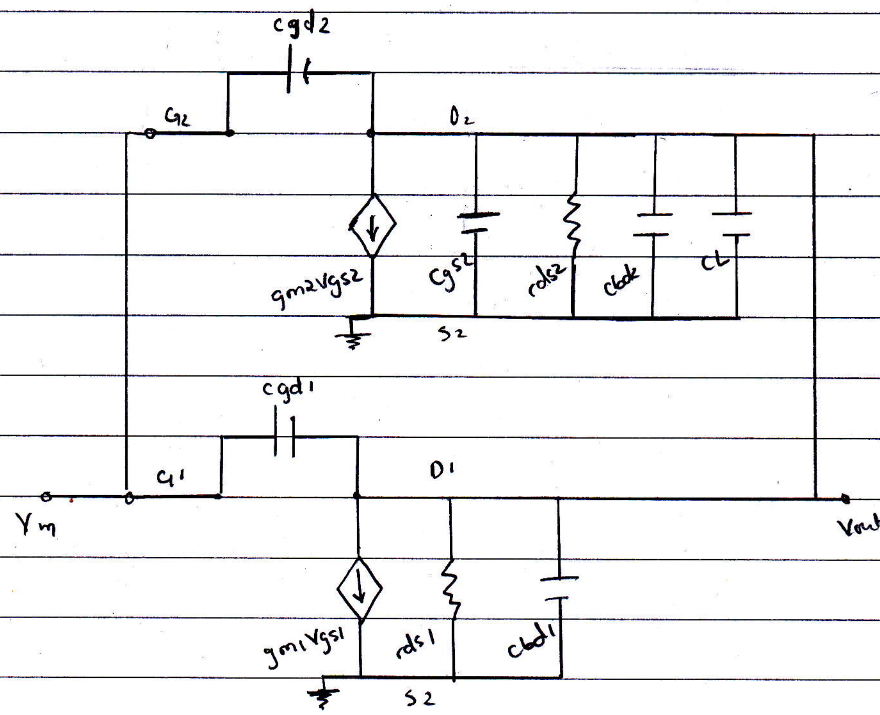
(a) determine the zero for the gain equation

(b) determine the equation for the pole.



Solution :





Small Signal Equivalence circuit

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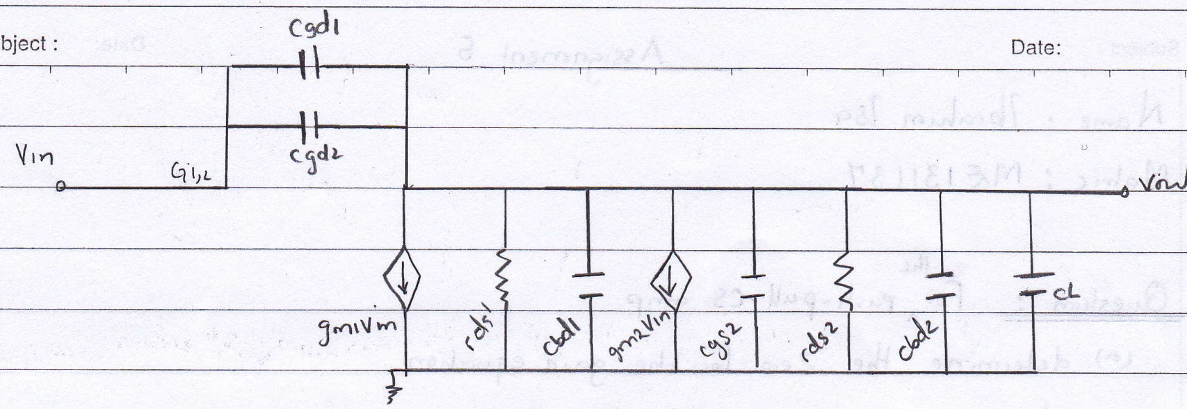

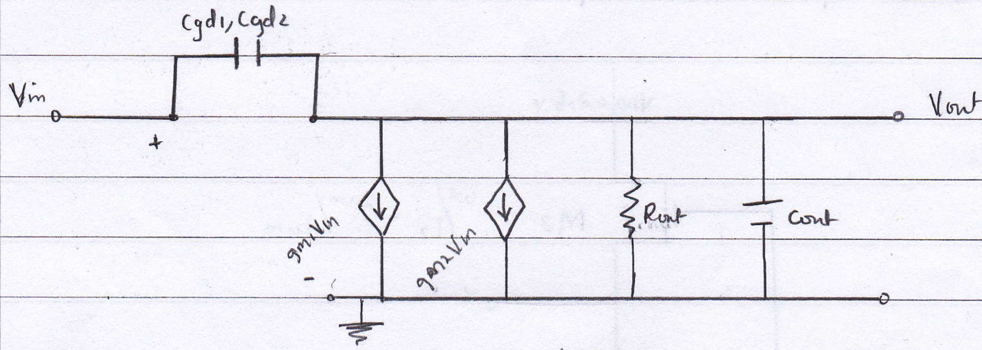

Simplified Circuit

$$R_{out} = r_{ds1} \,//\, r_{ds2} \;;\quad C_{out} = C_{bd1} + C_{gs2} + C_{bd2} + C_L$$

Gain (A_v) :

$$s(C_{gd1}+C_{gd2})(V_{out}-V_{in}) + g_{m1}V_{in} + g_{m2}V_{in} + V_{out}/R_{out} + sC_{out}V_{out} = 0$$

$$s(C_{gd1}+C_{gd2})V_{out} + V_{out}\left(1/R_{out} + sC_{out}\right) = s(C_{gd1}+C_{gd2})V_{in} - V_{in}(g_{m1}+g_{m2})$$

$$\therefore \frac{V_{out}}{V_{in}} = \frac{s(C_{gd1}+C_{gd2}) - (g_{m1}+g_{m2})}{s(C_{gd1}+C_{gd2}) + (1/R_{out} + sC_{out})}$$

$$= \frac{-(g_{m1}+g_{m2})}{1/R_{out}} \times \frac{\left(1 - \frac{s(C_{gd1}+C_{gd2})}{(g_{m1}+g_{m2})}\right)}{\left(1 + \frac{s(C_{gd1}+C_{gd2}+C_{out})}{1/R_{out}}\right)}$$

$$\therefore A_{(v)} = \frac{V_{out}}{V_{in}} \approx -R_{out}(g_{m1}+g_{m2}) \left[\frac{\left(1 - s\,(C_{gd1}+C_{gd2})/g_{m1}+g_{m2}\right)}{\left(1 + s\,R_{out}(C_{gd1}+C_{gd2}+C_{out})\right)}\right]$$

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Poles : Value of s when the denominator is "0"

$$1 + sR_{out}(C_{gd1} + C_{gd2} + C_{out}) = 0$$

$$sR_{out}(C_{gd1} + C_{gd2} + C_{out}) = -1$$

$$\therefore s = -\frac{1}{R_{out}(C_{gd1} + C_{gd2} + C_{out})}$$

Zero : Value of s when the numerator is "0"

$$1 - \frac{s(C_{gd1} + C_{gd2})}{g_{m1} + g_{m2}} = 0$$

$$\cancel{+}\frac{s(C_{gd1} + C_{gd2})}{g_{m1} + g_{m2}} = \cancel{+}1$$

$$\therefore s = \frac{g_{m1} + g_{m2}}{(C_{gd1} + C_{gd2})}$$