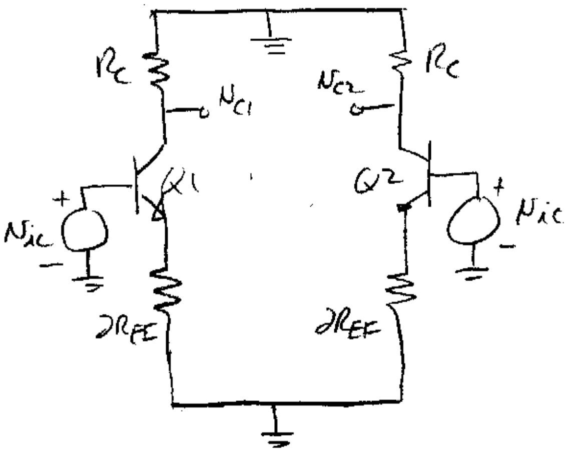
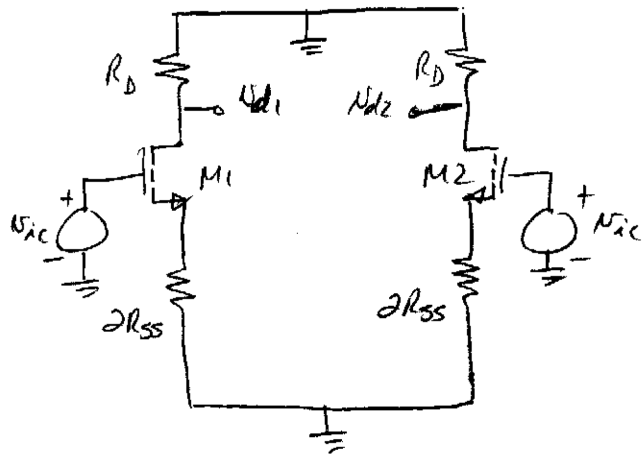
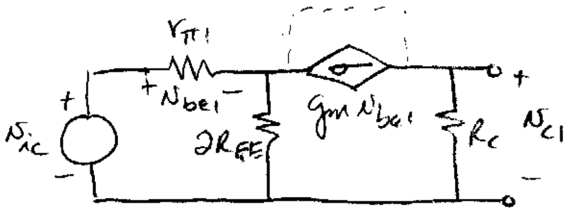
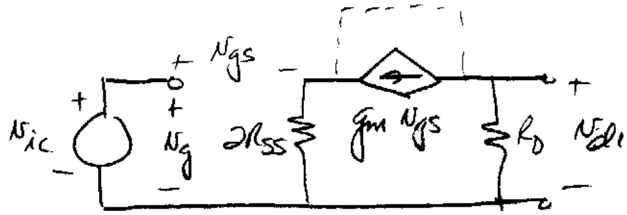
LECTURE 24

Common-mode Half Circuit –









$$A_{cd} = \frac{v_{c1}}{v_{ic}} = \left(\frac{v_{c1}}{v_{be1}}\right)\left(\frac{v_{be1}}{v_{ic}}\right)$$

$$v_{be1} = v_{b1} - v_{e1}$$

$$= v_{ic} - 2R_{EE}\left(\frac{1}{r_{\pi 1}} + g_{m1}\right)v_{be1}$$

$$\frac{v_{be}}{v_{ic}} = \frac{1}{1 + \frac{2R_{EE}}{r_{\pi 1}}(1+\beta_1)}$$

$$\therefore \frac{v_{c1}}{v_{ic}} = \frac{-g_{m1}R_C}{1 + \frac{2R_{EE}}{r_{\pi 1}}(1+\beta_1)}$$

$$= \frac{-\beta_1 R_C}{r_{\pi 1} + (1+\beta_1)2R_{EE}}$$

$$R_{ic} = \frac{v_{ic}}{2i_b} = \frac{r_\pi + (1+\beta)2R_{EE}}{2}$$

$$\therefore CMRR = \frac{|A_{dd}|}{|A_{cd}|} = \frac{g_m R_C}{2\beta_1 R_C}\left(r_\pi + (1+\beta)2R_{EE}\right)$$

$$= 1 + \frac{(1+\beta)2R_{EE}}{r_\pi} \simeq g_m R_{EE}$$

$$A_{cd} = \frac{v_{d1}}{v_{ic}} = \left(\frac{v_{d1}}{v_{gs}}\right)\left(\frac{v_{gs1}}{v_{ic}}\right)$$

$$v_{gs} = v_g - v_s = v_{ic} - g_m 2R_{SS} v_{gs}$$

$$\frac{v_{gs}}{v_{ic}} = \frac{1}{1 + 2g_m R_{SS}}$$

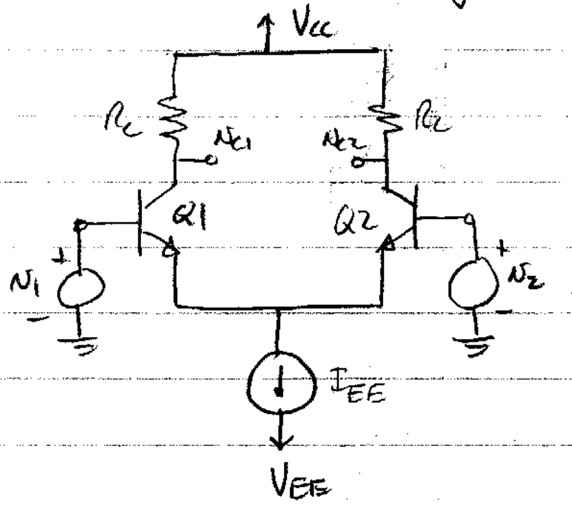
$$\therefore A_{cd} = \frac{g_m R_D}{1 + 2g_m R_{SS}}$$

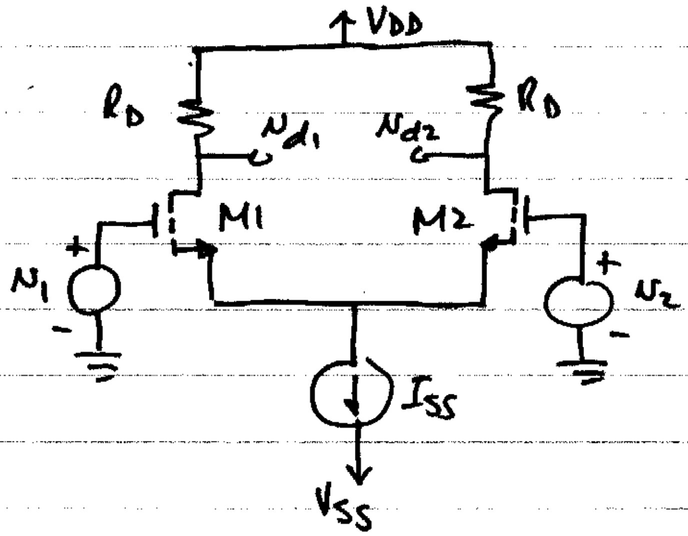
$$R_{ic} = \infty$$

$$CMRR = \frac{|A_{dd}|}{|A_{cd}|} = \frac{\frac{g_m R_D}{2}}{\frac{g_m R_D}{1 + 2g_m R_{SS}}}$$

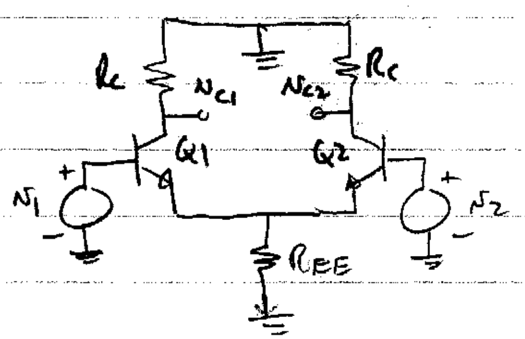
$$\simeq \underline{\underline{g_m R_{SS}}}$$

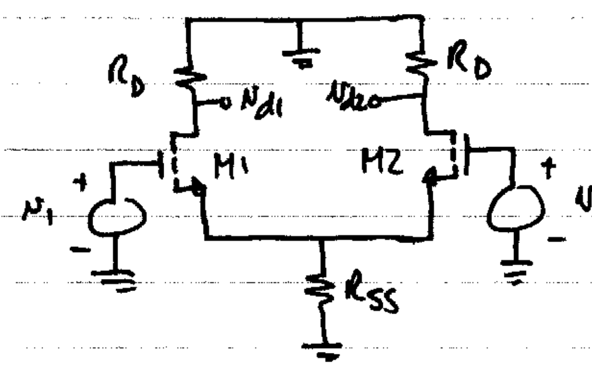
Current sink biasing of Differential Amplifiers



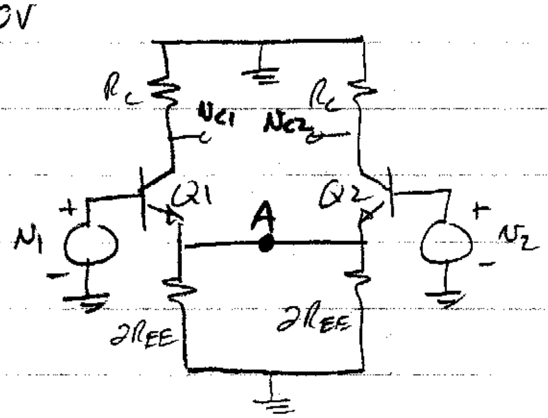


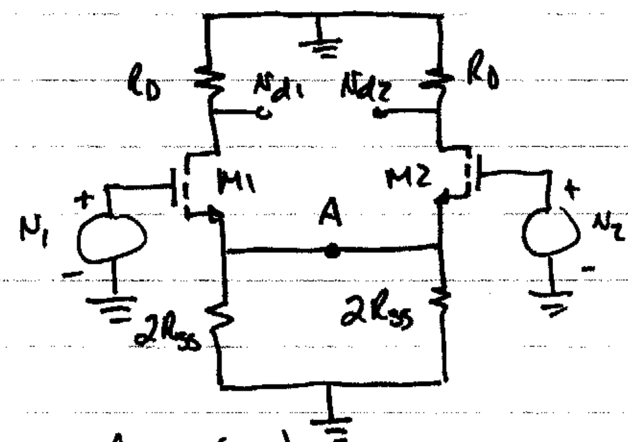
AC circuit -





0V





Now, for differential mode analysis (v_{id}) ground A and repeat the previous analysis

for common mode analysis (v_{ic}) cut the connection at A and repeat the previous analysis for half-circuits.