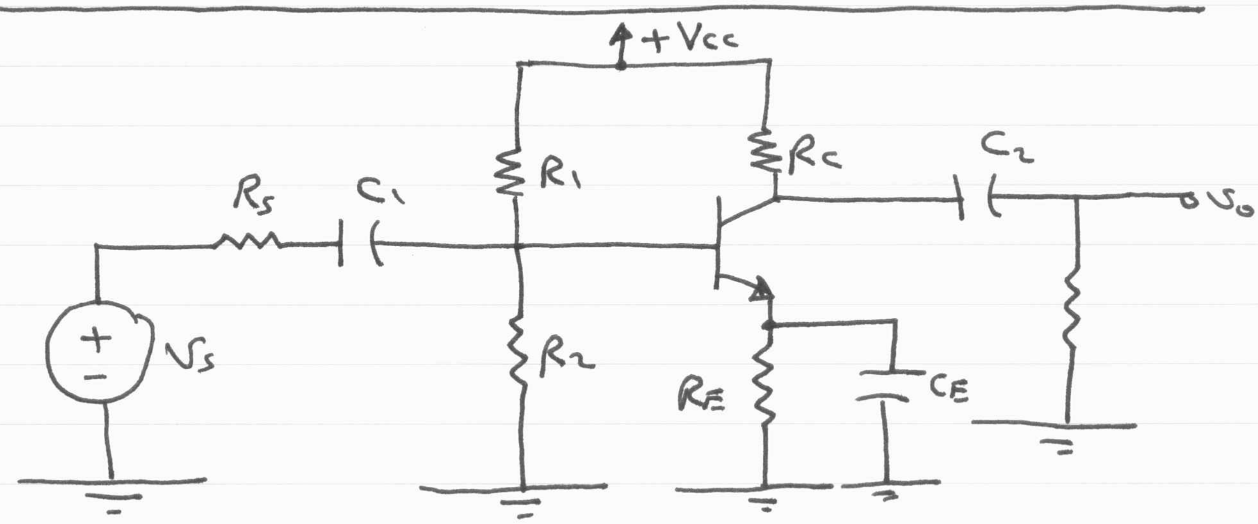
CE Amplifier Low-frequency Analysis

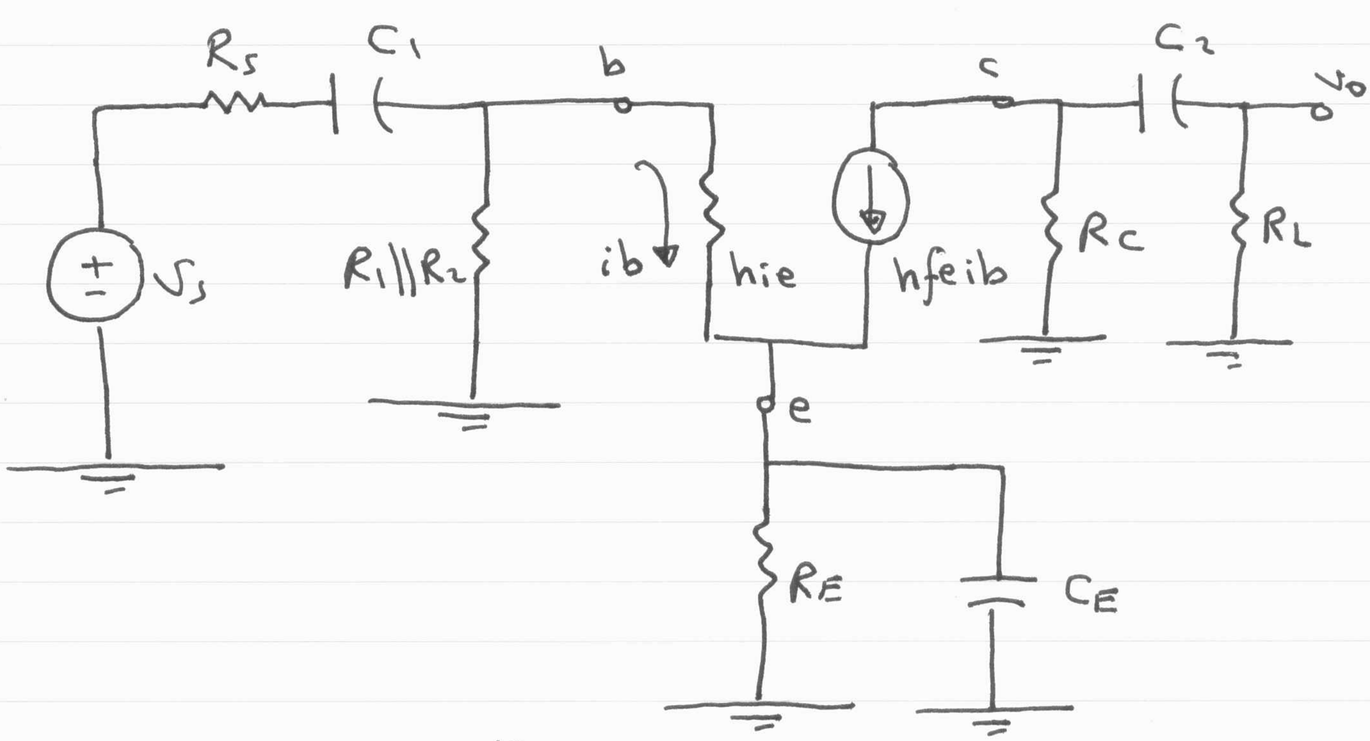


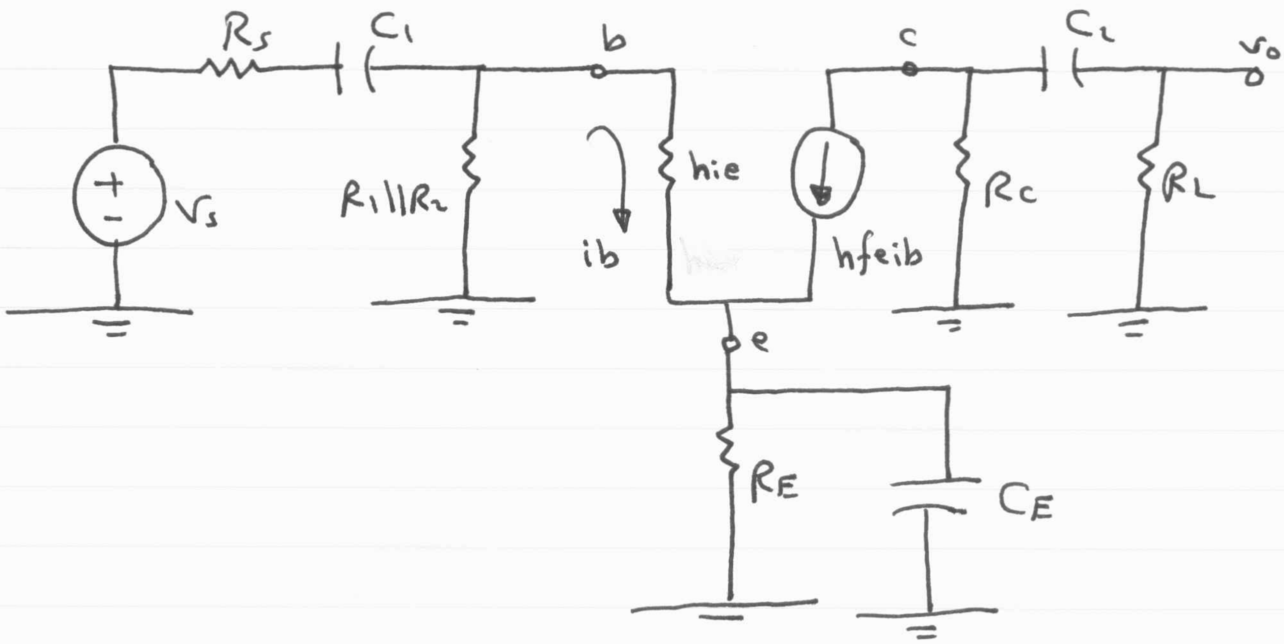
$h_{ie} = 10.45K$, $h_{fe} = 350$, $R_1 \| R_2 = 16.67K$

$R_C = 5K$, $R_L = 2K$, $R_E = 5K$, $R_s = 1K$

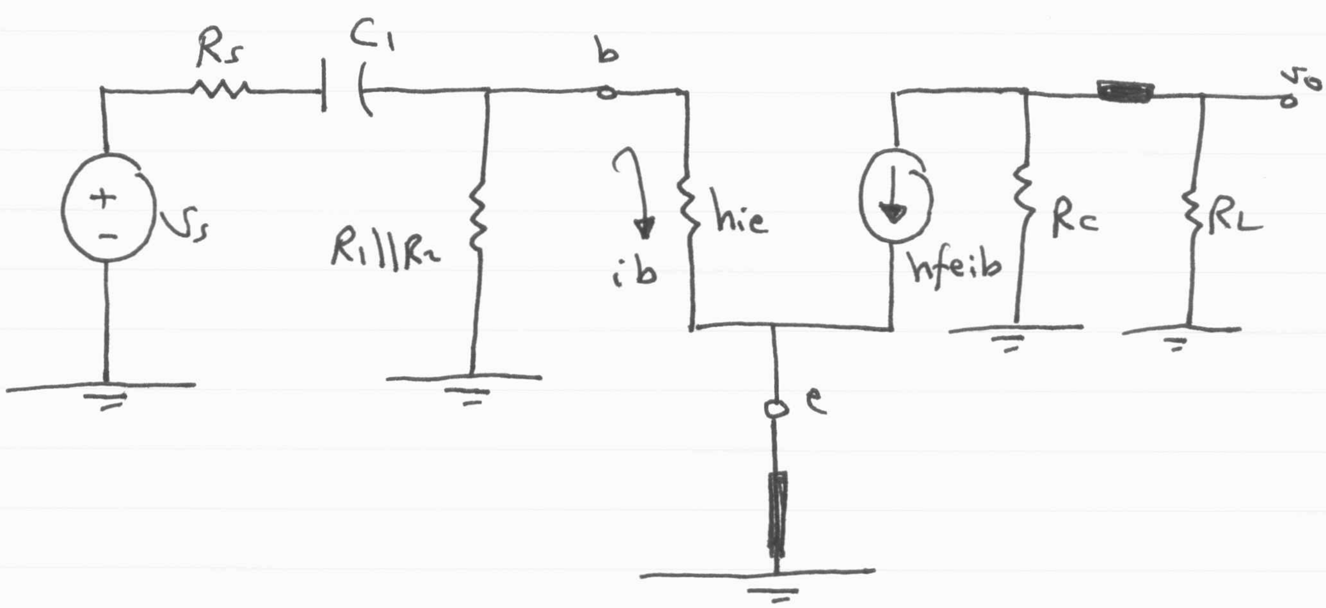
$C_1 = 3\,\mu F$, $C_2 = 8\,\mu F$, and $C_E = 50\,\mu F$

ac small signal Low-frequency equivalent CKT





1) To find ω_{C_1}, set C_E, and C_2 short

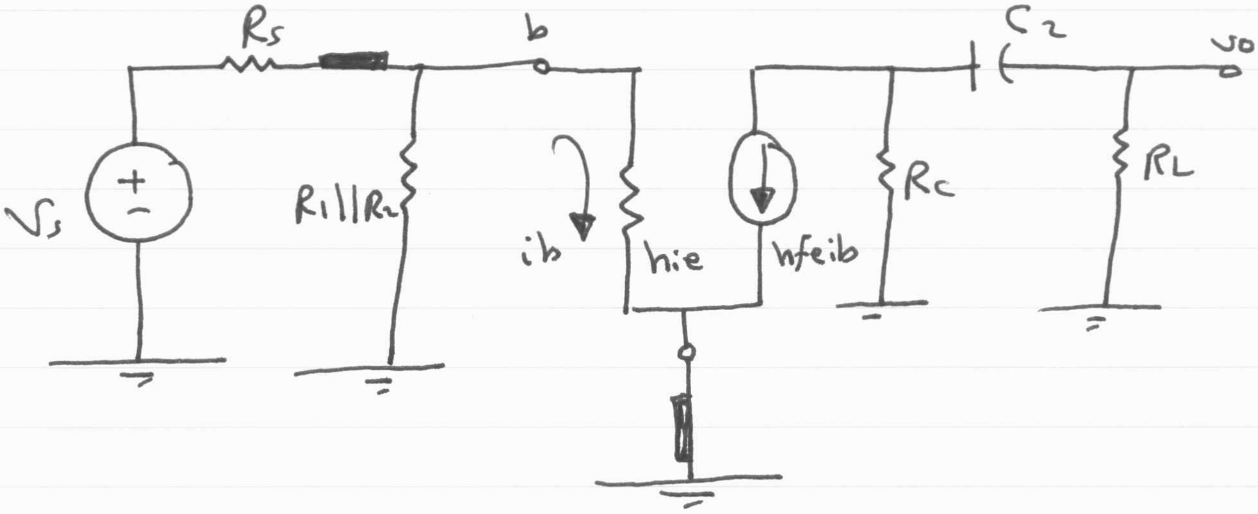


$$\omega_{C_1} = \frac{1}{R_{TH_1} C_1}$$

$$R_{TH_1} = R_s + (R_1 || R_2) || h_{ie}$$

$$\therefore \omega_{C_1} = 44.9 \text{ r/s}$$

2) To find ω_{c2} ; set C_1, and C_E Short

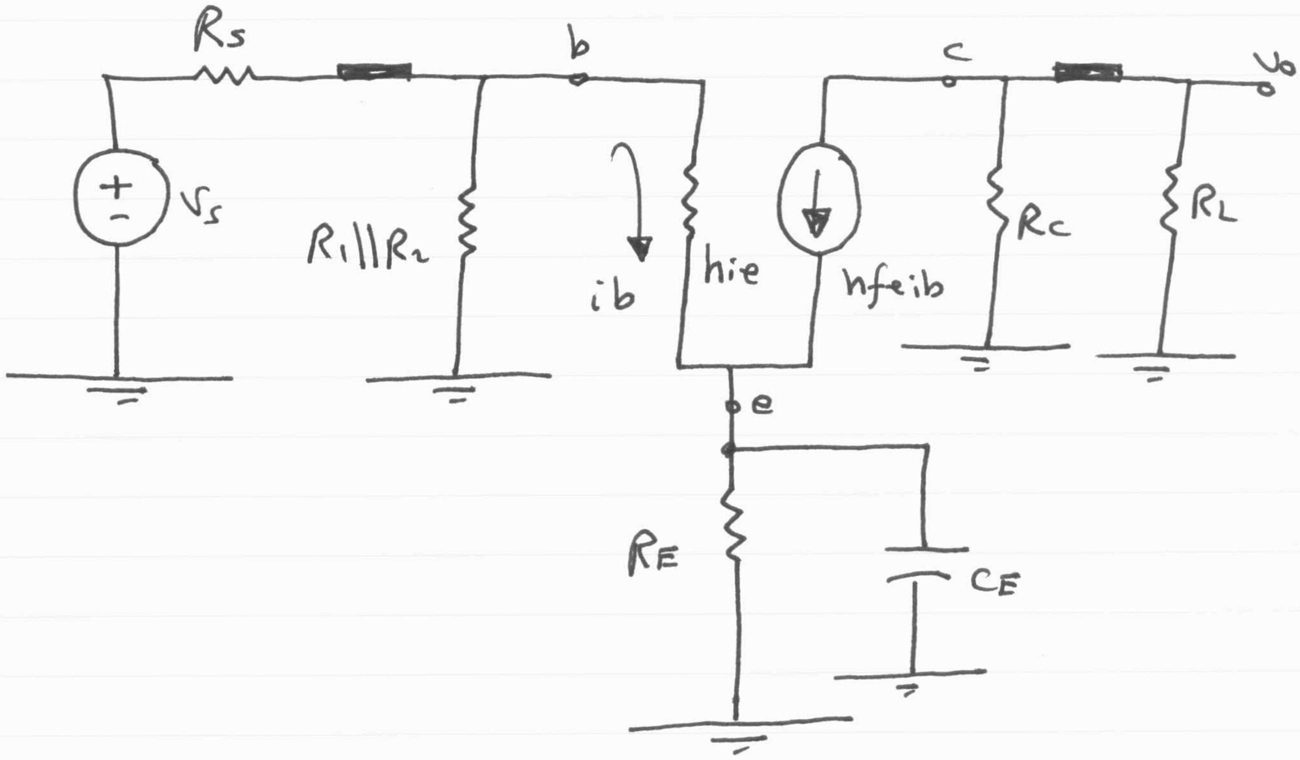


$$\omega_{c2} = \frac{1}{R_{TH2} C_2}$$

$$R_{TH2} = R_L + R_C$$

$$\therefore \quad \omega_{c2} = 17.86 \ r/s$$

3) To find ω_{CE} ; Set C_1, and C_2 short



$$\omega_{CE} = \frac{1}{R_{TH3} C_E}$$

$$R_{TH3} = R_E \,\Big\|\, \left(\frac{R_s \| R_1 \| R_2 + h_{ie}}{h_{fe}+1} \right)$$

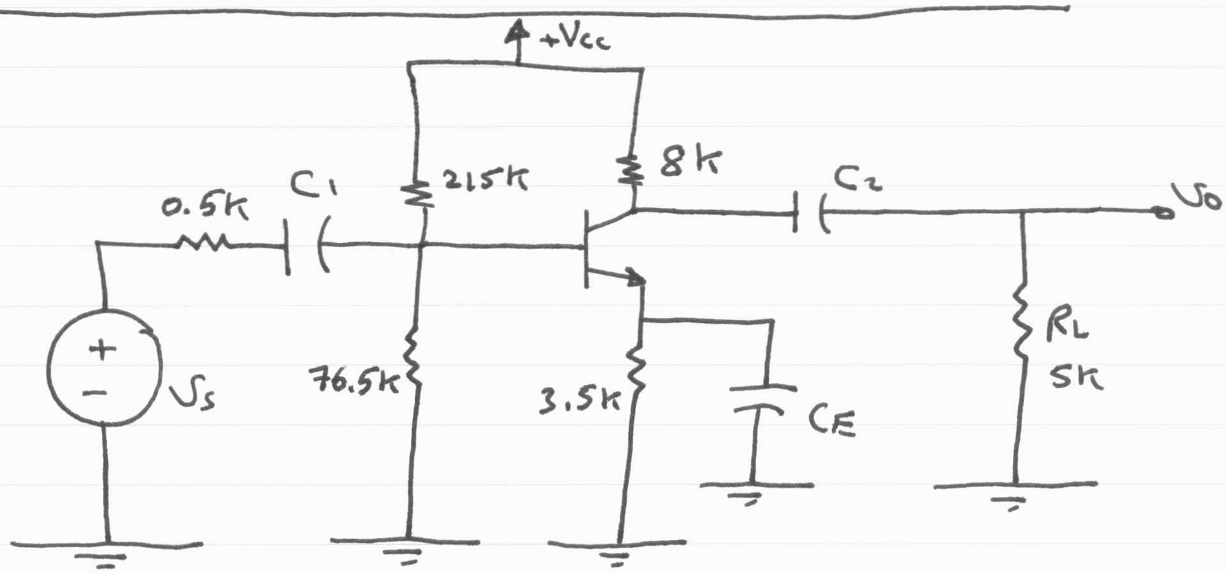
$\therefore \omega_{CE} = 616 \text{ r/s}$

$\omega_{C1} + \omega_{C2} + \omega_{CE} > \omega_L > \omega_{CE}$

$679 \text{ r/s} > \omega_L > 616 \text{ r/s}$

$\omega_L \equiv 645 \text{ r/s}$ Exact

CE Amplifier Low-frequency Design



$h_{fe} = 450$, and $h_{ie} = 5.78\,k$

Complete the design so that $\omega_L = 1000$ r/s

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* $\omega_{C1} + \omega_{C2} + \omega_{CE} = \omega_L = 1000$ r/s

* $\omega_{CE} \geq 70\%\ \omega_L$

$\omega_{CE} \geq 0.7\ \omega_L$

$\omega_{CE} = 890$ r/s

$\omega_{C1} = 100$ r/s

$\omega_{C2} = 10$ r/s

$$\omega_{CE} = \frac{1}{\left[R_E \,\Big\|\, \left(\frac{R_s \| R_1 \| R_2 + h_{ie}}{h_{fe}+1} \right)\right] C_E} = 890 \text{ r/s}$$

$$\therefore \quad C_E = 72.2 \, \mu F$$

$$\omega_{C_1} = \frac{1}{\left[R_s + R_1 \| R_2 \| h_{ie}\right] C_1} = 100 \text{ r/s}$$

$$\therefore \quad C_1 = 1.74 \, \mu F$$

$$\omega_{C_2} = \frac{1}{\left[R_C + R_L\right] C_2} = 10 \text{ r/s}$$

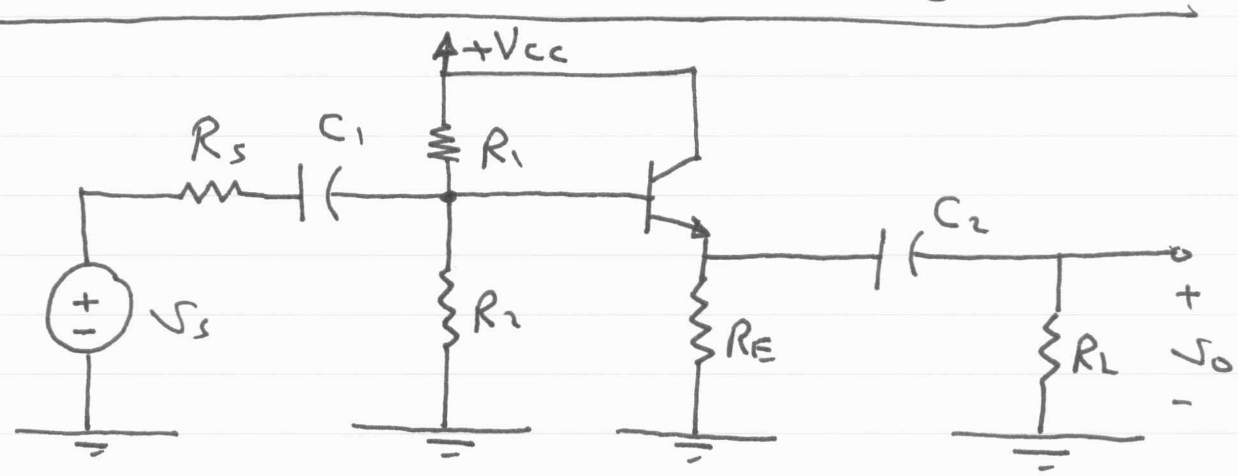
$$\therefore \quad C_2 = 1.54 \, \mu F$$

choose $C_E = 80 \, \mu F$

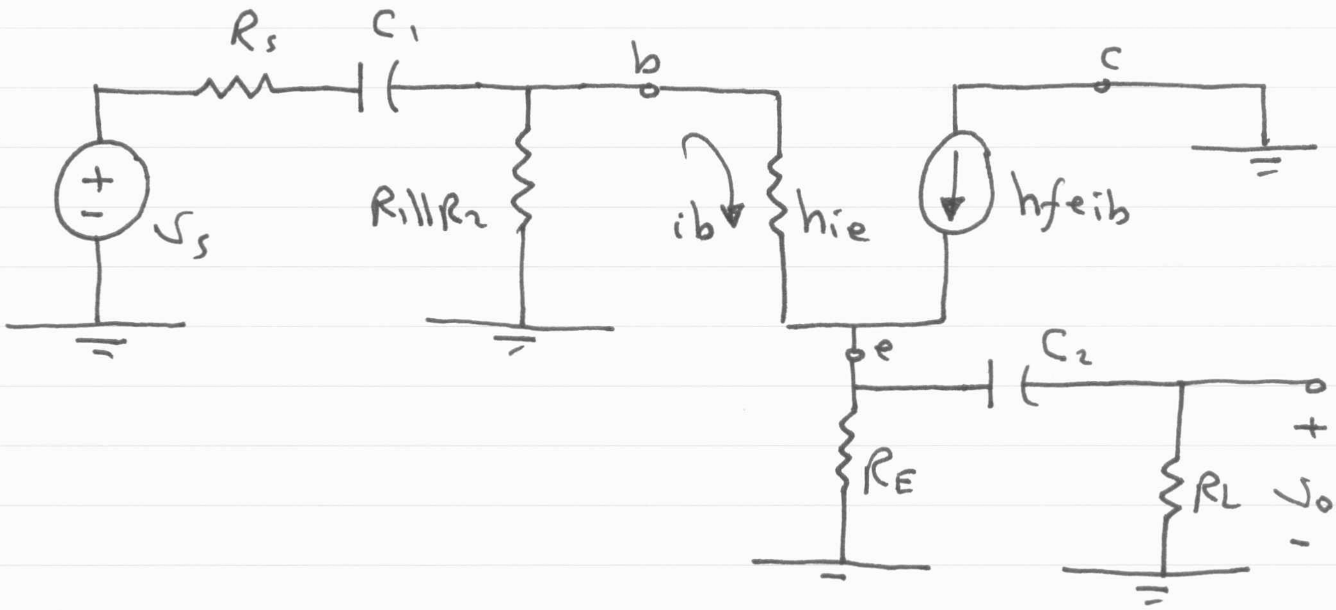
$C_1 = C_2 = 2 \, \mu F$

$$\therefore \quad \omega_L = 982 \text{ r/s}$$

Common Collector Low-Frequency Response



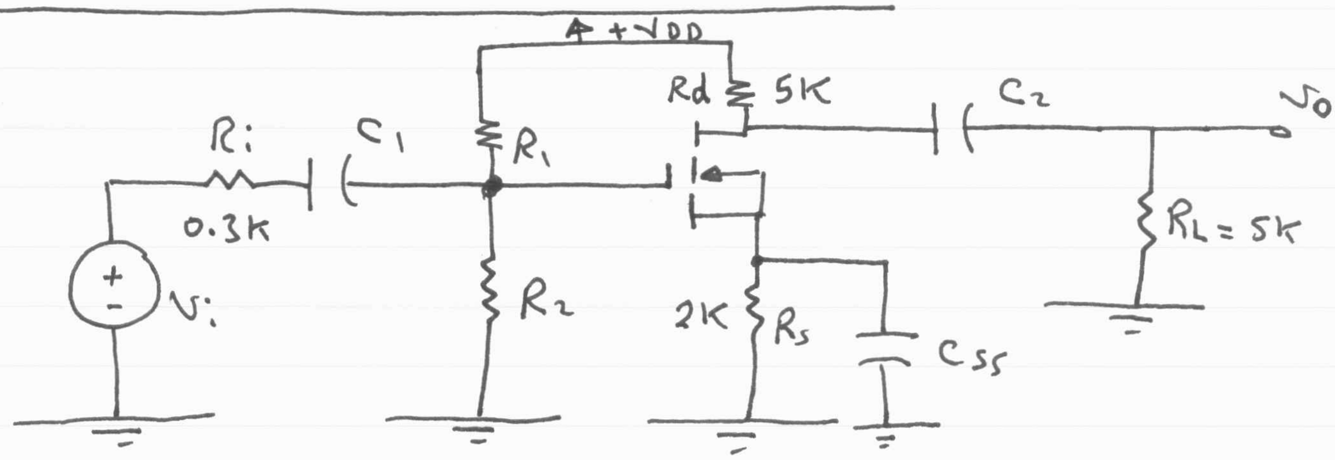
ac small signal Low-frequency equivalent CKT:



$$\omega_{c_1} = \frac{1}{C_1 \left[R_s + R_1 \| R_2 \| \left(h_{ie} + (R_E \| R_L)(1 + h_{fe}) \right) \right]}$$

$$\omega_{c_2} = \frac{1}{C_2 \left[R_L + R_E \,\Big\|\, \left(\dfrac{R_s \| R_1 \| R_2 + h_{ie}}{(h_{fe} + 1)} \right) \right]}$$

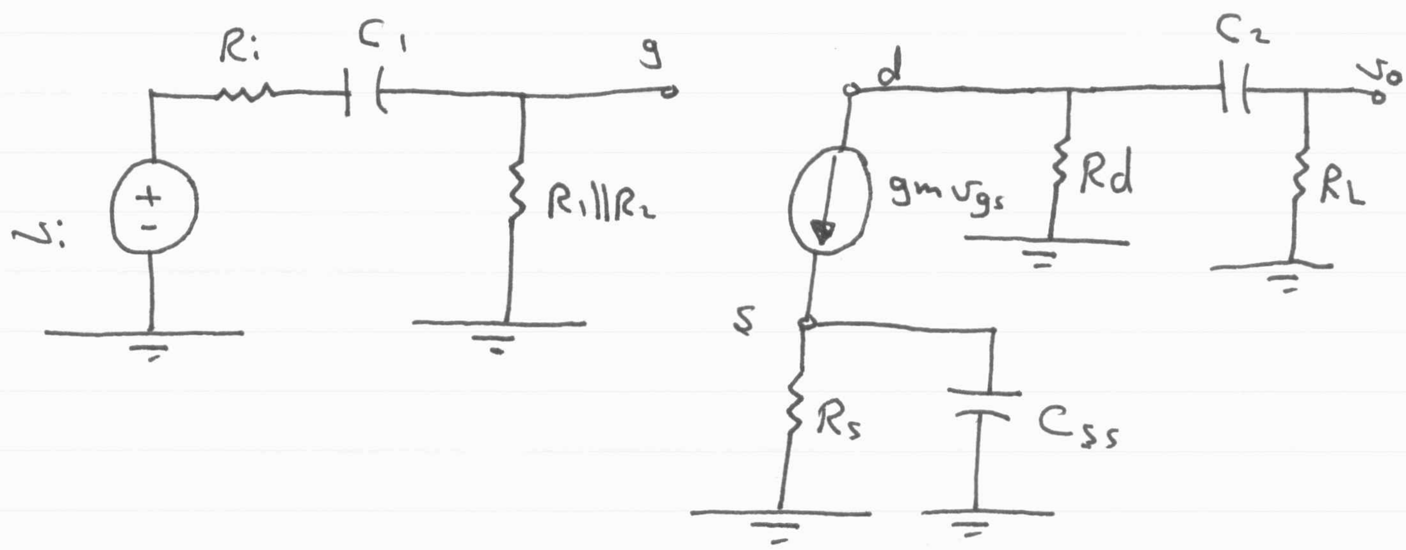
CS Low-Frequency Analysis



$R_1 \| R_2 = 100K$, $g_m = 10 m℧$

$C_1 = 0.2 \mu F$, $C_2 = 1 \mu F$, and $C_{SS} = 10 \mu F$

Ac small signal Low-frequency equivalent circuit :



$$\omega_{C_1} = \frac{1}{C_1 \left[R_i + R_1 \| R_2 \right]} = 49.9 \text{ r/s}$$

$$\omega_{C_2} = \frac{1}{C_2 \left[R_L + R_d \right]} = 100 \text{ r/s}$$

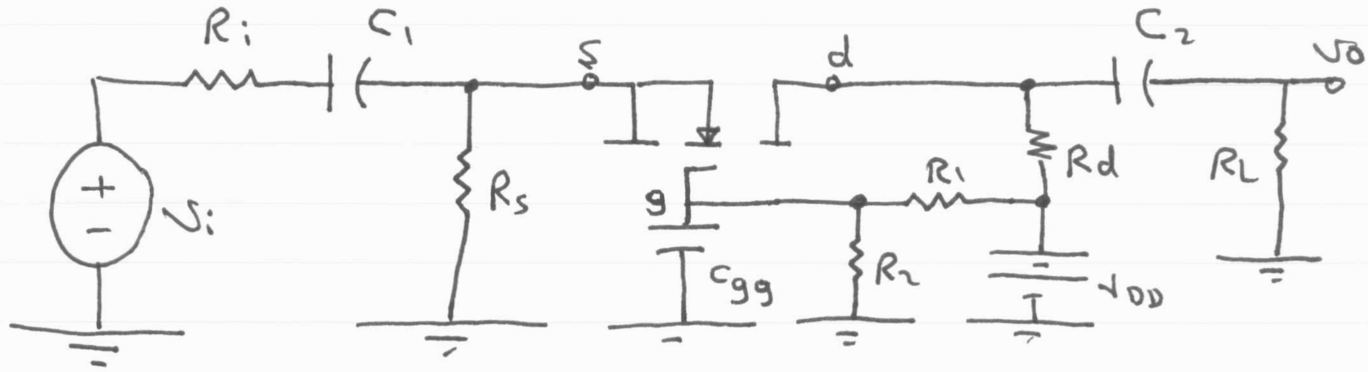
$$\omega_{css} = \frac{1}{C_{ss}\left[R_s \parallel \frac{1}{g_m}\right]} = 1050 \text{ r/s}$$

$$\omega_{c1} + \omega_{c2} + \omega_{css} > \omega_L > \omega_{css}$$

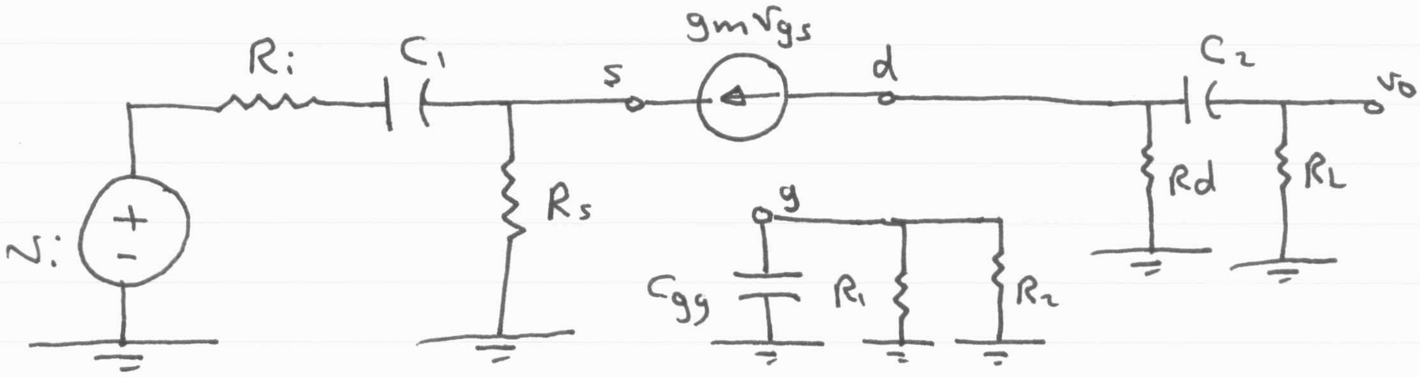
$$1199.9 \text{ r/s} > \omega_L > 1050 \text{ r/s}$$

$$\omega_L \equiv 1059.4 \text{ r/s}$$

Common Gate Low Frequency Analysis



Ac small signal Low-frequency equivalent CKT :



$$W_{c_1} = \frac{1}{C_1\left[R_i + R_s \| \frac{1}{g_m}\right]}$$

$$W_{c_2} = \frac{1}{C_2\left[R_L + R_d\right]}$$

$$W_{c_{gg}} = \frac{1}{C_{gg}\left[R_1 \| R_2\right]}$$