Lab 2b

29 October 2022 23:30

5.5.1 Lab #2b check-in requirements

The following items are due at the beginning of your Lab #2b session:

- ☐ The SPICE simulations for the stage 1 amplifier finished.
- ☐ The SPICE simulations for the stage 2 amplifier should be finished.
- ☐ Designed stage 2 amplifier including and resistor values calculated

CC stage calculations

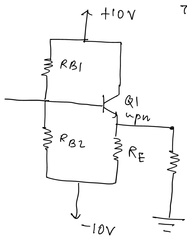
5.3.3 Common collector amplifier

In this amplifier the signal source is connected to the base and the load is connected to the emitter of the transistor.

- Here you have no RC, which means the maximum voltage swing is achieved simply when DC voltage on the emitter is in the middle between V- and V+;
- When choosing RE make sure that the current on load of CC amplifier does not exceed DC current on R_E;
- As you found V_E, it is easy to find V_B, R_1 and R_2.

Voltage Gain	$A_V = \frac{R_E \parallel R_L}{r_e + R_E \parallel R_L}$
Input Impedance	$R_{in} = R_1 \parallel R_2 \parallel [(\beta+1)(r_e + R_E \parallel R_L)]$
Output Impedance	$R_{out} = R_E \parallel \left[r_e + \frac{R_1 \parallel R_2 \parallel R_{source}}{\beta+1}\right]$

Circuit: CC part of the amplifier



To find: R_E, R_{B1} & R_{B2}

To find: R_1, R_2, R_3
V_E, V_B, V_{BE}

- when $V_E > 200\,mV$, we change R_1 & R_2 to keep $V_E < 200mV$

$V_E \approx 0V$, $I_B \cong 0A$ { For max power transfer, we assume $V_E \approx 0V$ }

For CE:

$i_{c,peak} = \frac{5}{1.2 \parallel 1.2} = 8.33mA$, $I_{c,DC(CE)} = 8.33mA$

$I_{c\,max} = i_{c,peak} + I_{c,DC(CE)} = 16.66mA$

For CC:

$I_{c,max} = 25mA - I_{c,max(CE)} = 8.34mA$

For max AC swing, $I_{c,DC(CC)} = \frac{8.34}{2} = 4.17mA$

As $I_B \approx 0$, $I_E = I_C = 4.17mA$

$R_E = \frac{0-(-10)}{I_E} = \frac{10[V]}{4.17[mA]} = 2.39808[k\Omega] \approx 2.4k\Omega$

$I_{bias} = \frac{I_E}{10} = 0.417mA$

$V_{BE} = V_B - \underbrace{V_E}_{0} \Rightarrow V_B = 0.7[V]$

$R_2 = \frac{V_B + 10}{I_{BIAS}} = \frac{10.7[V]}{0.417[mA]} = 25.6595[k\Omega] \approx 26k\Omega$

$I_{BIAS}(R1+R2) = V-(-V) \Rightarrow R_1 = \frac{2V}{I_{BIAS}} - R_2$

$R_1 = \frac{20[V]}{0.417[mA]} - \frac{10.7[V]}{0.417[mA]}$

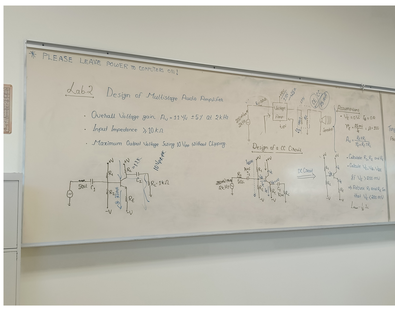
$R_1 = 22.302[k\Omega] \approx 22k\Omega$

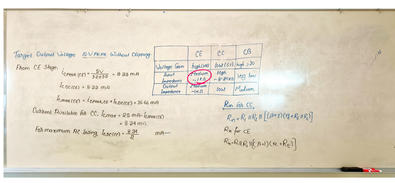
$R_{in} = R_1 \parallel R_2 \parallel [(\beta+1)(r_e + R_E \parallel R_L)]$

$R_{in} = (22[k\Omega]) \parallel (26[k\Omega]) \parallel [(100+1)(6\Omega + 2400[\Omega] \parallel 1000\Omega)]$

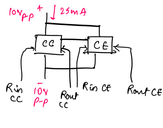
$= 11916.67 \parallel 71346.4$

$= 10.21\,k\Omega$





– R_{out} of CC = R_{in} of CE ≈ 1kΩ



– R_{in}:

a) for CC: $R_{in} = 10.21\,k\Omega$

b) for CE: $R_{in} = (22000) \parallel (1330) \parallel [(100+1)(2.97+63)]$

$= (1298.55) \parallel (7167.97)$

$= 1099.38\,\Omega$

$\approx 1k\Omega$