Course of **Analog Electronics** – 2022-2023

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Xmas homework #2

Exercise 1

Consider the two-stage amplifier in Fig. 1. The circuit parameters, at T = 25°C, are the following:

V_{DD} = 9 V, R_g = 1 kΩ, R_{G1} = R_{G2} = 100 kΩ, R_D = 5.6 kΩ, R_S = 1 kΩ, R_C = 10 kΩ, R_E = 2.2 kΩ;
R_F = 20 kΩ, C_g = 10 nF, C_F = 1 μF.

Q_1: V_{BE} = -0.7 V; β_F = 100; β_0 = 100; r_0 = +;
Q_2: V_t = 3 V; I_{DSS} = 2.25 mA ; r_0 = +;

V_T = 25 mV.

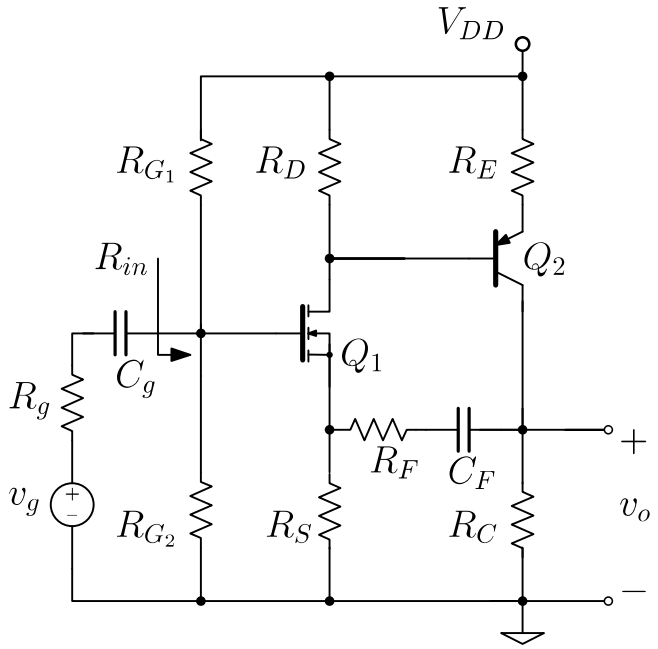


Fig. 1 – Two stage amplifier with feedback.

Considering all capacitors to be equivalent to open circuits, determine:

1. the operating points (V_{DS}, I_D) of Q_1 and (V_{CE}, I_C) of Q_2.

Assuming all capacitors to be equivalent to *short circuits* at the frequencies of interest, determine also:

2. the voltage gain of the amplifier, $A_v = v_o/v_g$;
3. the input resistance indicated in the figure.

Applying the time constant method and **neglecting capacitor C_F,** determine also:

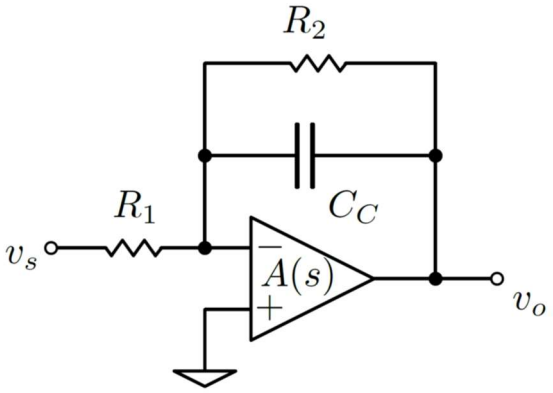
4. an estimation of the low frequency bandwidth limit of the amplifier.

Exercise 2

Consider the operational amplifier configuration shown in Fig. 2. The circuit parameters are the following:

R_1 = 1 kΩ; R_2 = 33 kΩ.

A(s) = $\frac{A_0}{\left(1+\frac{s}{\omega_{p1}}\right)\left(1+\frac{s}{\omega_{p2}}\right)}$ [V/V], with $A_0 = 10^5$ [V/V]; $\omega_{p1} = 10^2$ rad/s; $\omega_{p2} = 5 \cdot 10^3$ rad/s.



Determine:

1. an estimation of the circuit *phase* margin without C_C;
2. a block diagram representation of the amplifier, consistent with feedback theory;
3. the value of C_C that, ideally, makes the low pass filter bandwidth equal to the inverting amplifier's one (before compensation);
4. the new phase margin after C_C is placed in the circuit.