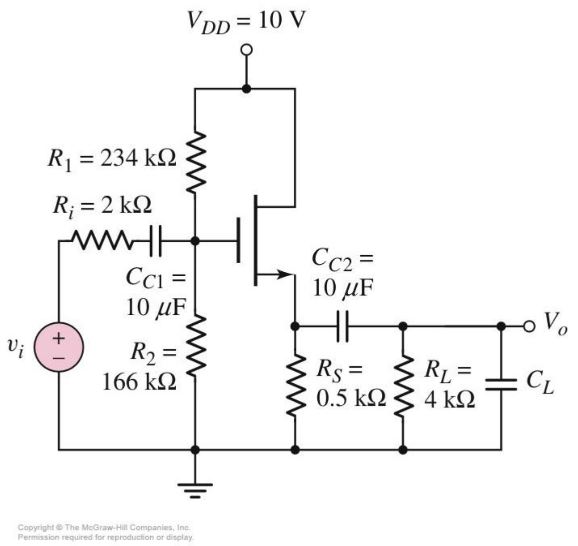
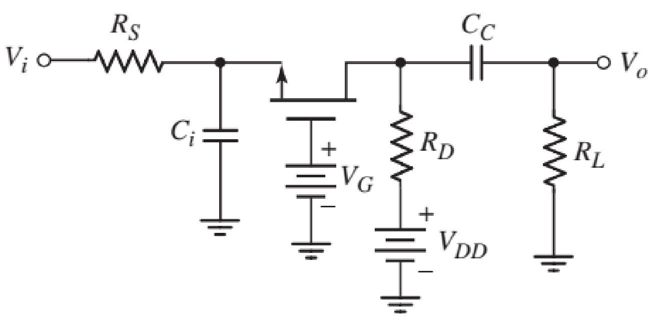
Electronics II, Midterm, Spring 2024
Department of Communication Engineering, National Central University
March 29, 2024, Prof. Dah-Chung Chang (E1-311)

1. (25%) Let $K_n = 0.5mA/V^2, V_{TN} = 2V$, and $\lambda = 0$.
   (a) Determine the maximum value of C_L such that the bandwidth is at least 5MHz. (15%)
   (b) What is the magnitude of the small-signal midband voltage gain? (10%)



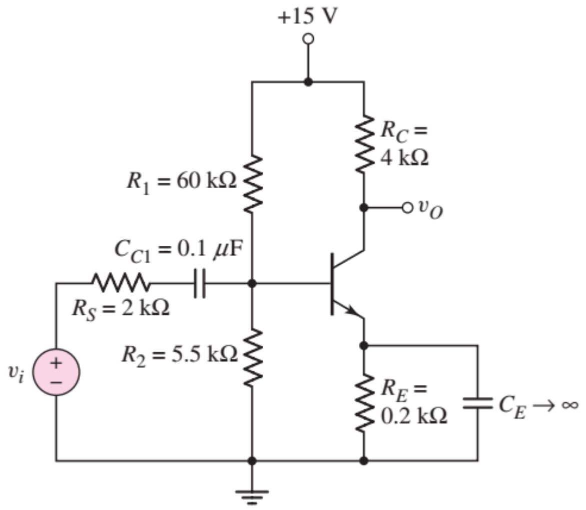
2. (25%) Consider the circuit as shown below.
   (a) Derive the transfer function $T(s) = V_o(s)/V_i(s)$, assuming λ = 0 for the transistor. Determine the expression for the time constant associated with the input portion of the circuit. (15%)
   (b) Determine the expression for the time constant associated with the output portion of the circuit. **You need to explain the equivalent resistance in the time constant, or you will not get the score.** (10%)



3. (25%) Assume the emitter bypass capacitor is very large, and the transistor parameters are:

$$\beta = 100,\ V_{BE(on)} = 0.7\text{V},\ V_A = \infty,\ C_\mu = 2\text{pF, and } f_T = 400\text{MHz}.$$

Determine the lower and upper 3 dB frequencies for the small-signal voltage gain.



4. (25%) Assume that C_{C1}, C_E, and C_{C2} acts as short circuits in this high frequency analysis.
   (a) Derive the 3dB upper corner frequencies in terms of the transistor capacitors C_μ and C_π. (10%)
   (b) Derive the midband voltage gain. (5%)
   (c) The circuit parameters are $V^+ = 10V$, $V^- = -10V$, $R_S = 0.1k\Omega$, $R_1 = 42.5k\Omega$, $R_2 = 20.5k\Omega$, $R_3 = 28.3k\Omega$, $R_E = 5.4k\Omega$, $R_C = 5k\Omega$, and $R_L = 10k\Omega$. The transistor parameters are $\beta_o = 150$, $V_{BE(ON)} = 0.7V$, $C_\pi = 12\,pF$, and $C_\mu = 2\,pF$. Given that the quiescent collector current $I_{CQ} = 1.02\,\text{mA}$, determine the values of 3dB upper corner frequency for C_L acting as an open circuit and for $C_L = 15\,pF$. (10%)