PROBLEM SET #9

Issued: Friday, October 30, 2020
Due: Friday, November 6, 2020 at 12:00 noon via Gradescope

1. Consider the common-emitter amplifier of Figure PS9.1 under the following conditions: $R_{\text{sig}} = 5k\Omega$, $R_{B1} = 33k\Omega$, $R_{B2} = 22k\Omega$, $R_E = 3.9k\Omega$, $R_C = 4.7k\Omega$, $R_L = 5.6k\Omega$, $V_{CC} = 5V$. The dc emitter current can be shown to be $I_E \approx 0.3\ mA$, at which $\beta = 120$.
   a) Find the input resistance $R_{\text{in}}$ and the midband gain $A_M$.
   b) For the same circuit, assume the BJT has a base resistance $r_x = 100\Omega$, $C_\pi = 10\ \text{pF}$, $C_\mu = 1\ \text{pF}$. Find the midband gain and the 3-dB frequency $f_H$.

![Figure PS9.1](image)

2. Sedra & Smith, Problem 10.18

3. For the same circuit in Problem 1 (b), find the value of $R_L$ that reduces the midband gain to half the value found. What value of $f_H$ results? Note the trade-off between gain and bandwidth.

4. For an emitter follower (Fig. PS9.2) biased at $I_C = 1\ mA$ and having $R_{\text{sig}} = R_L = 2k\Omega$, $r_o = 100k\Omega$, $\beta = 100$, $C_\mu = 2\ \text{pF}$, $C_L = 0$, and $f_T = 400MHz$, find the low-frequency gain $A_M$ and an estimate for $f_H$.

![Fig. PS9.2](image)