PROBLEM SET #7

Issued: Friday, October 12, 2018
Due: Friday, October 19, 2018, at 12:00 noon via Gradescope.

1. Sedra & Smith, Problem 7.92
2. Sedra & Smith, Problem 7.103
3. Sedra & Smith, Problem 7.24
4. Sedra & Smith, Problem 7.26
5. Sedra & Smith, Problem 7.33
6. What collector current is required for a bipolar transistor to achieve a transconductance of 30 mS? (Hint: Transconductance is equivalent to $y_{21}$ in the Y-parameter model discussed in lecture.)

7. Given that in the Y-parameter model for a BJT, 
   $$y_{11} = \frac{\partial i_B}{\partial v_{BE}} \bigg|_{\text{Q-point}} = \frac{I_C}{\beta_{ac}V_T}$$
show that the small-signal current gain, $\beta_{ac}$ can be defined as:
   $$\beta_{ac} = \frac{\beta_{DC}}{\left[1 - I_C \left(\frac{1}{\beta_{DC}} \frac{\partial \beta_{DC}}{\partial i_C} \bigg|_{\text{Q-point}}\right)\right]}$$

8. At what Q-point current will $r_n = 10 \text{ k}\Omega$ for a bipolar transistor with $\beta_{ac} = 75$? What are the approximate values of $g_m$ and $r_o$ is $V_A = 100 \text{ V}$? (Hint: $r_n$ is equivalent to $\frac{1}{y_{11}}$ in the Y-parameter model discussed in lecture.)

9. A circuit requires the use of a transistor with a transconductance of 0.5 S. A bipolar transistor with $\beta_{DC} = 60$ and a MOSFET with $K_n = 25 \text{ mA/V}^2$ are available. Which transistor would be preferred and why?