

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,

$$y_{11} = \left. \frac{\partial i_B}{\partial v_{BE}} \right|_{Q\text{-point}} = \frac{I_C}{\beta_{ac} V_T}$$

show that the small-signal current gain, β_{ac} can be defined as:

$$\beta_{ac} = \frac{\beta_{DC}}{\left[1 - I_C \left(\frac{1}{\beta_{DC}} \frac{\partial \beta_{DC}}{\partial i_c} \right)_{Q\text{-point}} \right]}$$

8. At what Q-point current will $r_\pi = 10 \text{ k}\Omega$ 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_π 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?