E151 Lecture 6 – Small Signal BJT Models and Regions of Operations in Circuits

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Disclaimer

These are note for Prof. Spencer to give the lecture, they were not intended as a reference for students. Students asked for them anyway, so I’m putting them up as a courtesy. Remember that they are not intended as a substitute for lecture.
Introduced BJTs Last Time

- Like two diodes, but short base region steals current sometimes.
- Started with device picture → Ebers-Moll (computer) model
- Now, go from Ebers-Moll to useful models:
  - Equivalent (large signal) circuits
  - Picture
  - Small signal models

Notes: I_ES = alpha*I_CS, simplify to one I_S, 1/alpha terms represent carrier injection in model

Circuit Models in Regions of Operation

- Specify each region in terms of BE jn on/off and BC jn on/off
- Link to what is on in Ebers-Moll,
- Clarify hitting V_CE,SAT → saturated
- Point to U shape conversions
- Ignoring small I elements

Rare and weird and bad!
Two Ways to Draw Ebers-Moll
\( \Rightarrow \) iC-vBE, iC-vCE

- \( i_B-v_{BE} \) is identical to \( i_C-v_{BE} \)
- Omitting breakdown
- Important Detail: Base Width Modulation

Small Signal in FAR Derivation

- Graphical, Ebers-Moll Equation Based, Diode argument, ic linear ib!
  Don’t forget to show \( gm*rp = \beta \)