Lecture 8

Michael Brodskiy
Professor: M. Onabajo

September 25, 2024

- PN-Junction Diodes
  - Shockley Equation ("Diode Equation")
    - More realistic model for the I-V characteristics (for FB and RB regions)
    - Based on semiconductor physics

$$i_D = I_s e^{V_D/(nV_T)} + 1$$

  - I_s is the saturation current (10^{-6} to 10^{-18}[A])
  - n = diode ideality factor, also called emissions coefficient, and can range from 1 to 2
  - $V_T = (kT)/q$ is the thermal voltage (≈ 26[mV] at $T = 300$[K] room temperature)
    - k = Boltzmann's constant ($1.38 \cdot 10^{-23}$[J/K]), q = electron charge ($1.6 \cdot 10^{-19}$[C])
- Temperature Dependence
  - At a constant current, the voltage drop decreases approximately 2[mV] for every 1[°C] increase in temperature
- Solving Circuits using the Junction Diode Model
  - Iterative Approach
    - Pro: accurate hand calculations
    - Con: tedious (time-consuming)
  - Graphical Approach
    - Pro: fast
    - Con: inaccurate (unless done numerically with a computer program)
  - Simulation
    - Pro: most accurate
    - Con: limited insights into the trade-offs