Lecture 5: September 12th, 2001

Graphical Solutions and Power

A) Load line method
B) Power
C) Nonlinear elements

Reading:
Schwarz and Oldham 3.2-3.3

Summary

- Load line method uses I vs. V for the element and finds the curve of I vs. V that satisfies the element.
- The circuit in which the element is to function is then characterized by a plot of I_{LOAD} vs. V_{LOAD} on the same axes by looking back into the circuit from the element and representing it as a Thevenin or Norton equivalent circuit.
- The intersection of these two curves gives a point or points that simultaneously meet the constraints of the element and the constraints of the circuit.
- Example: see 3.1 in text pp. 89 for an element; circuit is ideal voltage source and series resistor
  - **Case 1: 3V source and 100 ohms series resistor => 2.5V and 5 mA**
  - **Case2: 1V source and 100 ohms series resistor => 1.5V and –5 mA**

Summary

- Power into the element is $I_E V_E$ and is given by the rectangular area between the intersection point and the horizontal and vertical axes.
  - Case 1: (5 MA)(2.5V) = 12.5 mW
  - Case 2: (-5mA)(1.5V) = -7.5 mW
- Power from the source is $I_S V_S = I_E V_S$
  - Case 1: (5 MA)(3V) = 15 mW (rest is into resistor)
  - Case 2: (-5mA)(1V) = -5 mW (rest is into resistor)
- Nonlinear elements have I vs. V curves that are not straight but the procedure is the same
- Example: Light Emitting Diode – design a bias to produce 20 mA at 4 V
  - Three 1.5V batteries plus total of 25 ohms resistance
  - 9V battery plus 250 ohms of resistance
  - The former has better battery power to light efficiency but the latter is better in case high temperatures occur as the current versus voltage tends to double for every 5 degrees C.