ELEC 243
Problem Set 7
Homework Section
Due: March 13, 2015

The three problems from K&I assume ideal diodes. The final three problems require the full exponential model of a semiconductor diode.

H7.1 Work Problem 10.18 in K&I.

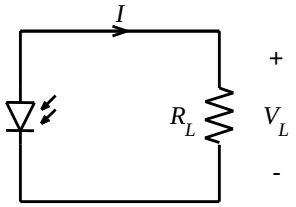
H7.2 Work Problem 10.21 in K&I.

H7.3 Work Problem 10.30 in K&I.

H7.4 A silicon diode has a value of I_0 of 10^{-10} A.

- **(a)** Plot the $i - v$ characteristic in the region $0 < i < 100\text{mA}$.
- **(b)** If the diode is placed in series with a 12 V source and a 500 Ω resistor, with the battery polarity such that the diode is forward biased, what current will flow? You may use an analytic, trial and error, or graphical solution technique.
- **(c)** What current will flow if the battery is reversed so as to reverse bias the diode?

H7.5 You have just been hired by Amalgamated Solar Energy Systems as a junior engineer. Your first assignment is to a team developing a solar powered electric heating system for birdhouses. The senior engineer on the team has completed the design and handed the circuit over to you to implement a prototype:



You go down to the stockroom and get a photocell labeled:

Avian Photodiode Co.
$I_0 = 1.61 \times 10^{-11}\text{A}$
Short-circuit Current = 86 mA
(in full sunlight)

What value should you choose for the resistor R_L so that the photocell will deliver maximum power to it under conditions of full sunlight?

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H7.6 Amalgamated Solar Energy Systems sister division, Amalgamated Lighting Systems, is engaged in fierce competition with Acme Illumination Inc. for control of the lucrative LED flashlight market. Following your success on the solar birdhouse project, you have been assigned to the Lighting division to help them reduce the cost of their product.

The original design (shown in the lefthand circuit below) used two identical LEDs in series. Your assignment is to redesign the flashlight so that it uses a single LED (as shown in the circuit on the right) but still produces the same amount of light as the original. Using the skills you developed in ELEC 243 lab, you produce the graph of i_D vs. v_D shown below.

(a) What value of R should be used so that the new flashlight will produce the same amount of light as the original?

(b) How long will the battery last in the new flashlight compared to the original?