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EECS 42 – Introduction to Electronics for Computer Science

Spring 2003, Prof. A. R. Neureuther
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Problem Set # 1

Due 2:30 PM January 29th, 2003 in box outside 275 Cory

Reading: Section 1.2-1.2 Schwarz and Oldham. Next week 1.3-1.4, 2.1-2.2

Homework: Exercise your physical, logical and graphical skills needed for electronics without the electronics terminology and parameters. (Pages 17-25, Truth-Tables 391-402 and graphical solution in Figure 3.19 may be useful.)

1.1 Flow. An orange tree has a density of 100 oranges per cubic meter. Each orange will produce 6 ounces of juice. A mathematical hula-hoop of radius 80 cm moves perpendicular to its surface through the tree at a velocity of 20 centimeters per second.

a) Find the number of oranges per second passing through the hula-hoop.
b) Find the number of quartz of orange juice produced per second.
c) How long does it take for 100 gallons of orange juice to pass through the hula-hoop?

1.2 Potential. Suppose that you are walking through a beautiful city for which the height above sea level in feet is $h(x,y) = 200 + 50x^2 + 100y$. Here x and y are the coordinates in blocks from the city center. Suppose you start at the market at (1, -1), go to the turning point (1,3) along x = 1, then to another turning point (4,3) along y = 3, and then to the view point (4,5) along x = 4.

a) Find the height climbed by evaluating the increase in height of each segment and adding.
b) Find the height climbed by evaluating the decrease in height of each segment, then adding these negative numbers and flipping the final sign. (Hopefully, this shows that if you are systematic adding increases or subtracting decreases give the same result.)
c) Choose any return path with at least two turning points besides the view point and market and find the height climbed. (Is the potential change independent of the path?)

1.3 Truth Tables. Find truth tables for the following Boolean functions.

a) $\overline{A(A+B)}$
b) $\overline{(AB)}$
c) $\overline{A} + \overline{B}$
d) Which of the above truth tables are identical and prove that their associated logical functions are equal? (You have just proven one form of DeMorgan's theorem.)

1.4 Graphical Solutions. On a sheet of graph paper plot the following three Y(x) functions from x = 0 to 5 and y = 0 to 0.012.

a) $Y_1(x) = 10^{-15} + 10^{-15}\, e^{(x/0.025)}$
b) For both k = 2 and k = 3 plot $Y_2(x) = 0.003(k-1)x$ when $x < 1$ and $Y_2(x) = 0.003(k-1)$ when $x > 1$.
c) $Y_3(x) = 0.010 - 0.002x$.
d) Find by reading your graph the (x,Y) value where $Y_3(x) = Y_1(x)$.
e) Find by reading your graph the (x,Y) value where $Y_3(x) = Y_1(x)$ for k = 2.

Note