RCET 3375 Experiment 2

Memory and Memory Systems

Goals: The student will be able to:

- Construct, and predict the outputs of various types of discreet, Read Only Memories (ROM's).
- Connect, and predict the outputs of various types of Random-Access Memories (RAM's).
- Describe Access Time (Ta) of memories.

Background Information

Memories, i.e. ROM's and RAM's, are used in computer systems to store programs and data. In general, the larger the memory, the larger the program that can be executed. Since ROM's are *non-volatile*, that is they do not lose their data when the power is shut off, they are used in applications where it is important that the program remain in memory even if the power is removed or power outages occur and it is not desirable to reload the data and programs on each power-up. The only drawback to a ROM is that once the ROM is loaded with the program and/or data, it is permanent. There are some types of ROM's that can be reprogrammed but it is slow. RAM's are generally used to hold programs and data for relatively short times and must be reloaded with each power-up. i.e. they are volatile. The programs and data can easily be rewritten as often as is necessary very rapidly. The *Access Time* (Ta) of a memory is defined as the time from when the address is asserted until valid data is present on the outputs.

Objectives:

** Remember to complete and document output loading calculations for **all** circuits.

1. Construct and prove the truth-table of the following ROM circuit.

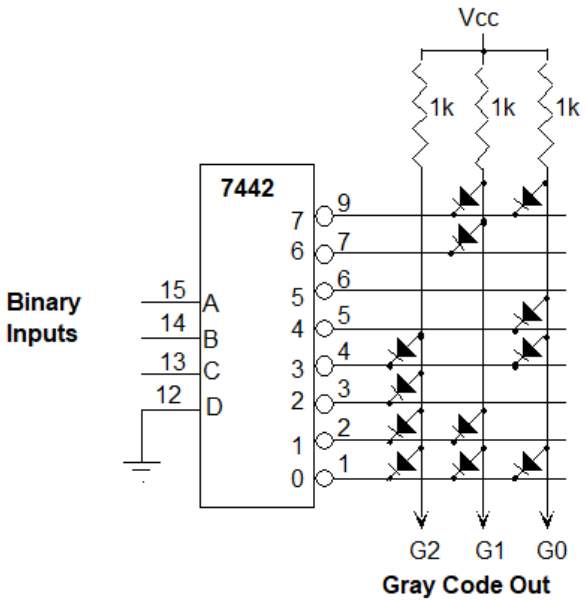

Figure 1: Binary to Gray Code Converter

2. Modify the previous ROM circuit to implement the following Boolean expressions in logic. Verify proper operation by verifying correct levels on the output pins for each input count. X replaces G_0.

$$X = ABC + AB\bar{C} + \bar{B}\bar{C}$$
$$Y = \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}C + AB\bar{C}$$
$$Z = \bar{A}B\bar{C} + ABC + \bar{A}BC + AB\bar{C}$$

3. Using mapping, simplify the above functions, make circuit and prove truth table.
   a. Compare the two circuits for the same truth table and number of diodes.

4. Using a 7442 and some diodes, design a 9's complementor for BCD Code. Make it as simple as possible, show maps and other simplification work.

5. Set up a 7489 RAM to write the following words into the assigned address.

ADDRESS	D3	D2	D1	D0
0	0	0	0	0
1	0	0	0	1
2	0	0	1	0
3	0	0	1	1
4	0	1	0	0
5	0	1	0	1
6	0	1	1	0
7	0	1	1	1
8	1	0	0	0
9	1	0	0	1
10	1	0	1	0
11	1	0	1	1
12	1	1	0	0
13	1	1	0	1
14	1	1	1	0
15	1	1	1	1

Table 1: Data for 7489

   b. Read the information out of the RAM at all addresses. How does the data out correlate to the data written into the RAM?
   c. After temporarily removing the power from the 7489. Read the data out of the RAM. How does the data correlate to what was written? Why?
   d. Show detailed diagrams of how each of the following three measurement below are made. Include voltages on each of the device pins required for the measurements. Also, show how measurement equipment is connected.
   e. Measure **Vol** on one data output pin.
   f. Measure **Ioh** on one data output pin.
   g. Measure **Iol** on one data output pin.
   h. Show waveforms that illustrate storing data in the RAM.

i. Show waveforms that illustrate reading data out of the RAM.