HW4

1. (20%) Design a combinational circuit with three inputs, x (MSB), y, and z (LSB), and three outputs, A (MSB), B, and C (LSB). When the binary input is 0, 1, 2, or 3, the binary output is three greater than the input (xyz=001 (1) => ABC=100 (4), xyz=011 (3) => ABC=110 (6).). When the binary input is 4, 5, 6, or 7, the binary is two less than the input (xyz=110(6) => ABC=100 (4), xyz=100 (4) => ABC=010(2)).
   (a) Derive the truth table. (5%)
   (b) Derive the simplified Boolean expressions for A, B, and C using maps. (10%)
   (c) Draw the related logic diagram. (5%)

2. (10%) Design an excess-3-to-binary decoder using the unused combinations of the code as don't-care conditions.

3. (10%) Design a combinational circuit that compares two 4-bit unsigned numbers A and B to see whether A is greater than B. The circuit has one output X, so that $X = 0$ if $A \leq B$ and $X = 1$ if $A > B$.

4. (10%) Design a 3-bit absolute value calculator. (Z=| z |).

5. (10%) Design a 4x4 multiplier using four-bit adders (Ripple-Carry adders) and other logic gates.

6. (20%) Design a three-way magnitude comparator that outputs true if its three inputs are in strict order: a>b>c. a, b, and c are all three-bit unsigned numbers.

7. (10%) Design a 4->2 priority encoder with input D[3:0] and output A[1:0] where D_0 has the highest priority and D_3 has the lowest priority.

8. (10%) Which of the following circuits are combinational? Each box in the figure is itself a combinational circuit.