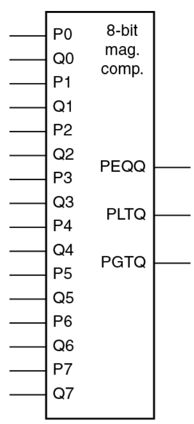
14:332:231-Digital Logic Design
Assignment 5

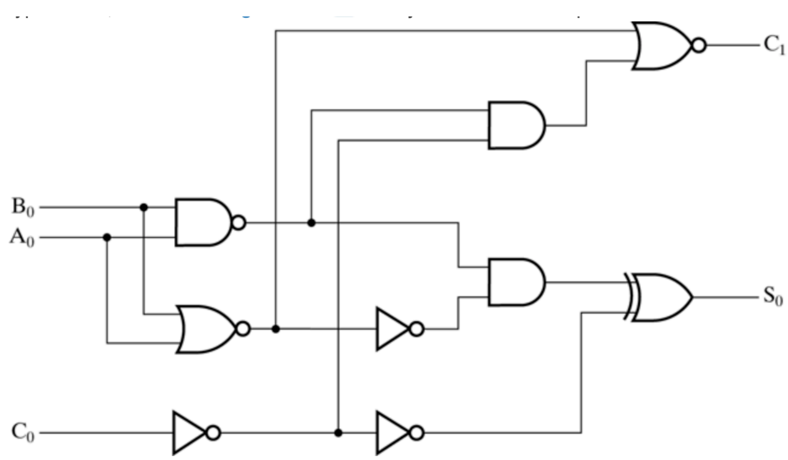
Due Date: 04/03/2023, 2:00 pm

1. Design a 2-bit comparator that accepts two 2-bit two's-complement numbers A (a_1a_0) and B (b_1b_0) and produces three outputs indicating whether A>B, A=B and A<B. Construct the truth table, find the Boolean expression for each output, and implement the circuit using basic logic gates.

2. The 8-bit comparator shown below accepts two 8-bit unsigned numbers P and Q, and produces three outputs indicating whether P=Q (PEQQ), P<Q (PLTQ), or P>Q (PGTQ). Use three of this module and few basic logic gates to design a 24-bit comparator that compares two 24-bit unsigned numbers A and B, and produces two outputs indicating whether A=B or A>B.



3. Find expressions for C_1 and S_0 in the circuit shown below and determine what the circuit does.



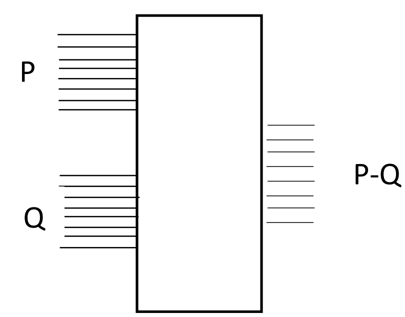
4. Using full adders, design a circuit that accepts a 4-bit binary number and increments it by one.

5. A combinational circuit is designed to accept a 4-bit number and produce the two's-complement of the input number at its output. Construct the truth table for this circuit, and find Boolean expressions for the outputs, and design the circuit using

a) only basic logic gates

b) four cascaded half-adders

6. The circuit below accepts two two's-complement 8-bit numbers P and Q and outputs their difference (P-Q). Use two of this circuit and additional basic logic gates (if needed), and build a circuit that compares three two's-complement 8-bit numbers A, B and C, and produces an output of **1** if A > B > C, and **0** otherwise.



7. Using only full adders, design a circuit that accepts a 7-bit binary number, and produces a 3-bit output that is equal to the number of "1"s in the input number. For example, if the input is 1111111, the output is 111, and if the input is 1110000, the output is 011.