CS 429 Homework 3

Name: ___________________________ Section #: _______________________

Instructions: Work these problems carefully on your own paper. As usual, you may collaborate with your classmates and ask for assistance from the TA. But don’t copy anyone else’s answer. Each problem is worth the same number of points (more or less).

1. Write the truth table and a C expression for NAND. Show how you could implement NAND using gates from the set \{OR, NOT\}.

2. Show that \{NAND\} is functionally complete by implementing \{OR, NOT\} using only NAND.

3. Design a 3-bit even parity circuit (i.e., returns 1 if an even number of the 3 bits are 1, and 0 otherwise).
   (a) Show the truth table.
   (b) Show a circuit implementation using only gates from the set \{AND, OR, NOT\}.
   (c) Show a circuit implementation using only NAND gates.

4. Given your even parity circuit above, explain how you could implement an odd parity circuit using only one additional gate.

5. (10 points) Consider the following circuit diagram with boolean inputs A, B, C, D. Say what signal is on the line at points: \(T_1\), \(T_2\), \(T_3\), \(T_4\), \(T_5\), \(F_1\), \(F_2\). (E.g., what boolean function of inputs B and C is on the line at the point marked \(T_1\)?) Use earlier results in later results. For example, express \(T_3\) as a function of A and \(T_1\). (That way you can get \(T_3\) right, even if you missed \(T_1\).) Use C logical notation to describe each signal.

6. Extra credit (challenging) Is \{XOR, NOT\} a functionally complete set of gates? Give a rigorous argument.