P1. (10 points) Problem 2.10 in the textbook.

P2. (10 points) Problem 2.11 in the textbook.

P3. (10 points) Problem 2.20 in the textbook. Show all steps.

P4. (10 points) Draw a circuit diagram for the function in P3 using NAND gates only.

P5. (10 points) Consider two functions S and C of three input variables X, Y, and Z. S is logic 1 if and only if the number of input variables equal to 1 is odd (the sum is one or three). Otherwise it is logic 0. C is logic 1 if and only if the number of input variables equal to 1 is two or more. Otherwise it is logic 0. Write the truth tables for the functions S and C. This is called a 3-bit adder.

P6. (10 points). Write the functions S and C from P5 in short hand notation using (a) min terms and (b) max terms. Also write functions S and C in canonical sum-of-products (SOP) and canonical product-of-sums (POS) forms.

P7. (10 points) Simplify the expressions for the functions S and C in problem P6 and draw their respective circuit diagrams.

P8. (10 points) Let L(A,B,C,D) be a four-way light control with four switches A,B,C, and D. (a) Write the truth table for the function L. (b) Write the canonical sum-of-products expression for the function L. (c) Write the canonical product-of-sums expression for the function L.

P9. (10 points) Show how to implement a NOT function using: (a) 2-input NAND, (b) two input NOR, and (c) a two input multiplexer.

P10. (10 points) By applying DeMorgan's Theorem directly to the following circuit, convert it into one that uses only: (a) NAND gates and NOT gates. (b) NOR gates and NOT gates.

\[ X_1 \quad X_2 \quad X_3 \quad f \]