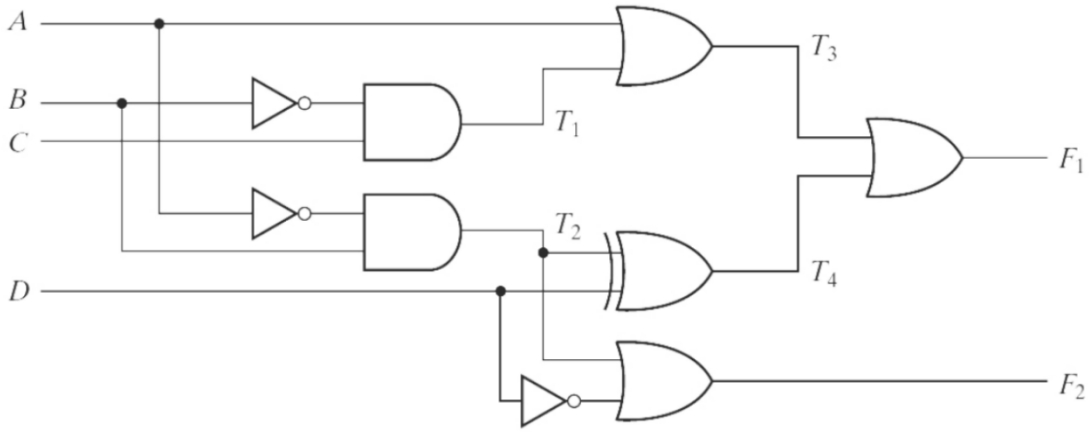
Digital Logic

2024 Fall Assignment 2

- Write neatly and submit a PDF file to Blackboard before deadline.
- Write down ALL procedures. Only presenting the final answer will lead to a zero, even the answer is correct.
- Box or underline your final answers when applicable.
- 请通过 http://10.25.60.181:8080（sustechwifi）或 http://susdigitallogic.if4.ttyt.cc/ (公网可访问，但可能速度较慢) 提交电路图，并在 bb 上提交完整的纸质版（包括电路图）

1. (20 points 10+10) Simplify the following Boolean function F(A, B, C, D)= ∑(1, 2, 4, 7, 8, 9, 11), together with the don't-care conditions d(0, 3, 5), and express the simplified Boolean function using （注意：表达式和电路图均需要，只有电路图将仅酌情得分）:
   a) NAND gates only using algebraic method, and draw the logic diagram corresponding to your function
   b) NOR gates only using algebraic method, draw the logic diagram corresponding to your function

2. (24 points 12+12) Obtain the simplified Boolean expressions for output F_1 and F_2 in terms of the input variables in the following circuit.
   a) Derive the Boolean expressions for T_1 through T_4. Evaluate the outputs F_1 and F_2 as a function of the four inputs.
   b) List the truth table of the four input variables. Then list the binary values for T_1 through T_4 and outputs F_1 and F_2 in the table.



3. (18 points 8+5+5) Design a combinational circuit with three inputs, A, B, and C, and three outputs, F1, F2, and F3. When the binary input is 0, 1, or 2, the binary output is two greater than the input. When the binary input is 3, 4, 5, 6, or 7, the binary output is one less than the input. You need to provide:
   a) List the truth table
   b) K-map simplification
   c) Draw the logic diagram

4. (18 points 6+6+6) A combinational circuit is defined by the equations
   F1=AB+A'B'C'
   F2=A+B+C'
   F3=A'B+AB'
   Design a circuit which implements these three equations using a decoder and NOR gates external to the decoder, and draw the block diagram.

5. (20 points 8+6+6) An 8:1 multiplexer has inputs A, B, and C connected to the selection inputs S_2, S_1, and S_0, respectively. The data inputs I_0 through I_7 are as follows: I1=I2=0; I3=I5=I7=1; I0=I4=D; and I6=D'. Determine the Boolean function F(A, B, C, D) that the multiplexer implements. You need to:
   a) Write down the truth table
   b) Simplify the Boolean function with K-map
   c) Redesign the circuit with ONLY 4:1 multiplexers