

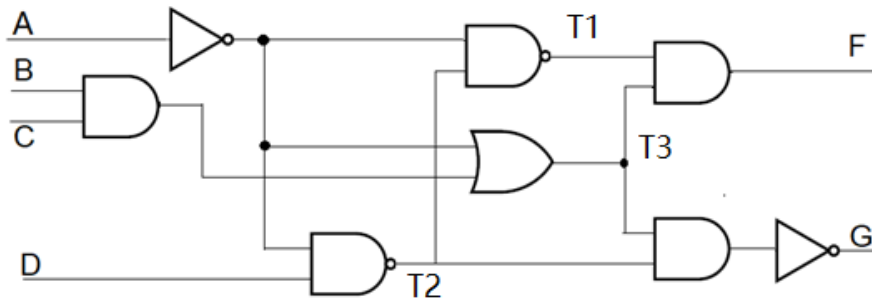
Digital Logic

2023 Fall Assignment 2

- **Write neatly** and submit an e-copy to Blackboard on time.
- **Do write down all procedures.** Only presenting the final answer will lead to a zero, even the answer is correct.
- Box answers when applicable.

1. (20 points 5+10+5) Obtain the simplified Boolean expressions for output F and G in terms of the input variables in the following circuit.

- Determine the function from the logic diagram by identifying the logic function of T1, T2, T3, F and G. (**Don't simplify**)
- Simplify the Boolean function for final outputs F and G **algebraically**. (**Now you need to simplify**)
- Show the truth table of the circuit of final output F and G based on A, B, C and D



2. (10 points) A circuit has four inputs and two outputs. The inputs $A_3A_2A_1A_0$ represent a number from 0 to 15 (in binary). Output P should be TRUE if the number is prime (0 and 1 are not prime, but 2, 3, 5, and so on, are prime). Output D should be TRUE if the number is divisible by 3 (noted 0 is divisible by any value). You need to provide:

- The Truth table
- K-map simplification (**You need to clearly circle the adjacent cells**)

3. (15 points) 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 NAND gates external to the decoder, and draw the block diagram.

4. (10 points) Develop a 3-to-8 line decoder using NOR gates only, and draw its logic diagram. **You can use ' to express the complement form of input variable.**

5. (15 points) 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: $I_1=I_2=0$; $I_3=I_5=I_7=1$; $I_0=I_4=D$; and $I_6=D'$. Determine the Boolean function $F(A, B, C, D)$ that the multiplexer implements. You need to:

- a) Write down the truth table (Make sure you write in correct order)
 - b) Simplify the Boolean function with K-map (You must show how you cover the adjacent squares)
6. (30 points) Implement the Boolean function $F(A, B, C, D) = \sum(1, 9, 10, 12, 13, 14) + d(4, 5, 8)$ using the following components. Invalid values are considered as don't care. For each question, you also need to draw the logic or block diagram. If necessary, you can use extra gates while implementing using decoder or mux. **You need to use as less standard components and gates as possible.** (Show the procedure for each question, and you must ensure that the input and output pins position are clearly denoted when using decoder and mux)
- a) Write down the truth table
 - b) standard logic gates and draw the logic diagram
 - c) one 74154 decoder (You can use the symbol for 74154 in lecture slides), and draw the block diagram
 - d) two 3-to-8-line decoders with enable, and draw the block diagram
 - e) one 8-to-1 multiplexer, where A,B,C are the selection signals, and draw the block diagram
 - f) one 4-to-1 multiplexer, where B,C are the selection signals, and draw the block diagram