JOINT INSTITUTE
交大密西根学院

Ve270 Introduction to Logic Design

Homework 3

Assigned: October 8, 2019

Due: October 15, 2019, 4:00pm.

The homework should be submitted in hard copies.

1. Problem 2.57 (15 points)
2. Problem 2.58 (15 points)
3. Problem 2.59 (15 points)

2.57 A network router connects multiple computers together and allows them to send messages to each other. If two or more computers send messages simultaneously, the messages "collide" and must be re-sent. Using the combinational design process of Table 2.5, create a collision detection circuit for a router that connects 4 computers. The circuit has 4 inputs labeled M0 through M3 that are 1 when the corresponding computer is sending a message and 0 otherwise. The circuit has one output labeled C that is 1 when a collision is detected and 0 otherwise.

2.58 Using the combinational design process of Table 2.5, create a 4-bit prime number detector. The circuit has four inputs—N3, N2, N1, and N0—that correspond to a 4-bit number (N3 is the most significant bit) and one output P that is 1 when the input is a prime number and that is 0 otherwise.

2.59 A car has a fuel-level detector that outputs the current fuel-level as a 3-bit binary number, with 000 meaning empty and 111 meaning full. Create a circuit that illuminates a "low fuel" indicator light (by setting an output L to 1) when the fuel level drops below level 3.

4. Problem 2.74 (15 points)

2.74 A house has four external doors, each with a sensor that outputs 1 if its door is open. Inside the house is a single LED that a homeowner wishes to use to indicate whether a door is open or closed. Because the LED can only show the status of one sensor, the homeowner buys a switch that can be set to 0, 1, 2, or 3 and that has a 2-bit output representing the switch position in binary. Create a circuit to connect the four sensors, the switch, and the LED. Use at least one mux (a single mux or an *N*-bit mux) or decoder. Use block symbols, each with a clearly defined function, such as "2x1 mux," "8-bit 2x1 mux," or "3x8 decoder"; do not show the internal design of a mux or decoder.

5. Show how four 2-to-1 and one 4-to-1 MUXs could be connected to form an 8-to-1 MUX. (5 points)
6. Show how to make a 6-to-1 MUX using an 8-to-1 MUX. (5 points)
7. Use one 4-to-1 MUX and one inverter to implement a digital circuit for following truth table. (5 points)

a	b	c	F
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0

8. Use one 3-by-8 decoder and other components to implement a digital circuit for above truth table. (10 points)
9. Design an 8-bit ALU described in the following functional table. Use building blocks. (10 points)

TABLE 4.2 Desired calculator operations

Inputs			Operation	Sample output if A=00001111, B=00000101
x	y	z		
0	0	0	S = A + B	S=00010100
0	0	1	S = A - B	S=00001010
0	1	0	S = A + 1	S=00010000
0	1	1	S = A	S=00001111
1	0	0	S = A AND B (bitwise AND)	S=00000101
1	0	1	S = A OR B (bitwise OR)	S=00001111
1	1	0	S = A XOR B (bitwise XOR)	S=00001010
1	1	1	S = NOT A (bitwise complement)	S=11110000

10. Highlight the critical paths of the following circuit. Assume that each gate (including the individual inverters and XOR gates) has a delay of 1 ns and each wire has a delay of 0.5 ns. (5 points)