

Name: _____

Problem	Points	Score
1a	10	
1b	10	
1c	10	
1d	10	
2a	10	
2b	10	
3a	10	
3b	10	
3c	10	
3d	10	
Total	100	

Notes:

1. The exam is closed book / closed notes. Students are allowed a copy sheet — only **one** side of **one** standard US-size (8.5" x 11") sheet of paper — on which they can write relevant information such as theorems.
2. Please show ALL work. Incorrect answers with no supporting explanations or work will be given no partial credit.
3. If I can't read or follow your solution, it is wrong, and no partial credit will be given — PLEASE BE NEAT!
4. Please indicate clearly your answer to every problem.
5. There is sufficient space after each problem to write your solution. In case you need extra paper please see the instructor.
6. Calculators of any kind are not allowed.

Problem No. 1:

The locking mechanism to the entrance of your company building uses a 4-bit code to open. To unlock the door, you must enter 4 bits ABCD such that the corresponding decimal number is odd or a multiple of some odd number greater than 1. In other words, the door unlocks if the input is not 0, 2, 4 or 8.

- a) Draw the truth table and the corresponding Karnaugh map to represent the network implementing this lock. An output of 1 indicates that the door is unlocked.

- b)** Realize a minimum network for this locking mechanism using two-level logic and only NAND gates. Write the number of gate inputs required.

- c) Realize a minimum network for this locking mechanism using three-level logic and AND-OR gates. Write the number of gate inputs required.

- d)** Convert the three-level network of part **c** into a network with only NOR gates.

Problem No. 2:

You have been recently hired by an electronics company. Your predecessor was fired because he did not know how to design networks with more than 4 inputs. You are now assigned to his unfinished project to design the following 5-input network —

$$F = \sum m(0, 1, 2, 6, 8, 9, 10, 11, 20, 23, 28, 31) + \sum d(3, 17, 21, 25, 30)$$

- a) Your predecessor has left the following unfinished Quine-McCluskey table. Complete it to obtain all the prime implicants.

0,1	0000-
0,2	000-0
0,8	0-000
<hr/>	
1,3	000-1
1,9	0-001
1,17	-0001
2,3	0001-
2,6	00-10
2,10	0-010
8,9	0100-
8,10	010-0
<hr/>	
3,11	0-011
9,11	010-1
9,25	-1001
10,11	0101-
17,21	10-01
17,25	1-001
20,21	1010-
20,28	1-100
<hr/>	
21,23	101-1
28,30	111-0
<hr/>	
23,31	1-111
30,31	1111-

- b)** Draw the prime implicant chart from the completed table in part **a** and find all minimum sum-of-product expressions for F .

	0	1	2	6	8	9	10	11	20	23	28	31

Problem No. 3:

A leading medical electronics company is designing a logic network that will perform preliminary diagnosis on patients based on the presence or absence of four symptoms ABCD. The diseases to be diagnosed are XYZ, and their relationship with the symptoms is as follows —

ABCD	XYZ
0000	000
0001	110
0010	000
0011	100
0100	110
0101	001
0110	011
0111	100

ABCD	XYZ
1000	010
1001	110
1010	111
1011	111
1100	010
1101	011
1110	000
1111	100

- a) Draw the K-maps for X, Y and Z to implement this network as a 4-input 3-output system.

- b)** Find a minimum 2-level AND-OR network to implement this system. Draw the corresponding network diagram.

- d)** Implement the function for X using an 8-to-1 multiplexer with A , B and C as the control inputs.