Points missed: _____ Student's Name: _____

Total score: _____ /100 points

East Tennessee State University
Department of Computer and Information Sciences
CSCI 2150 (Tarnoff) – Computer Organization
TEST 2 for Spring Semester, 2003

Section 001

Read this before starting!

- The total possible score for this test is 100 points.
- This test is closed book and closed notes.
- **All** answers **must** be placed in space provided. Failure to do so may result in loss of points.
- **1 point** will be deducted per answer for missing or incorrect units when required. **No** assumptions will be made for hexadecimal versus decimal, so you should always include the base in your answer.
- If you perform work on the back of a page in this test, indicate that you have done so in case the need arises for partial credit to be determined.
- ***Calculators are not allowed.*** Use the tables below for any conversions you may need. Leaving numeric equations is fine too.

Binary	Hex
0000	0
0001	1
0010	2
0011	3
0100	4
0101	5
0110	6
0111	7

Binary	Hex
1000	8
1001	9
1010	A
1011	B
1100	C
1101	D
1110	E
1111	F

Power of 2	Equals
2^3	8
2^4	16
2^5	32
2^6	64
2^7	128
2^8	256
2^9	512
2^{10}	1K

"Fine print"

Academic Misconduct:

Section 5.7 "Academic Misconduct" of the East Tennessee State University Faculty Handbook, June 1, 2001:

"Academic misconduct will be subject to disciplinary action. Any act of dishonesty in academic work constitutes academic misconduct. This includes plagiarism, the changing of falsifying of any academic documents or materials, cheating, and the giving or receiving of unauthorized aid in tests, examinations, or other assigned school work. Penalties for academic misconduct will vary with the seriousness of the offense and may include, but are not limited to: a grade of 'F' on the work in question, a grade of 'F' of the course, reprimand, probation, suspension, and expulsion. For a second academic offense the penalty is permanent expulsion."

1. How many cells total does a 3 variable Karnaugh map have? (2 points)

2. In a 4-variable Karnaugh map, how many variables (e.g., A, B, C, etc.) does a product have if its rectangle of 1's contains 4 cells? (2 points)

3. If a group of four rows or columns in a Karnaugh map is identified with two variables, it is numbered 00, 01, 11, 10 instead of 00, 01, 10, 11. Why? (4 points)

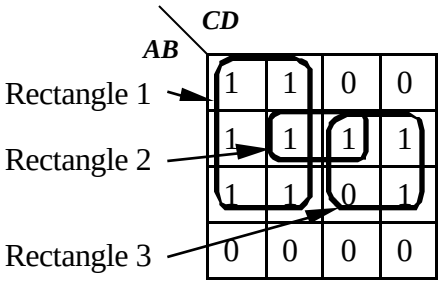
4. Create a Karnaugh map from the truth table below. Do not worry about making the rectangles. (5 points)

A	B	C	D
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	0
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	1

5. Derive the minimum SOP expression from the Karnaugh map below. (6 points)

AB \ ***CD***	0 0	0 1	1 1	1 0
00	1	0	1	1
01	0	0	1	0
11	0	1	1	0
10	0	1	1	0

6. For the Karnaugh map to the right, identify the problems with each of the three rectangles shown. (2 points each)

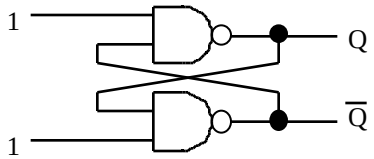


Rectangle 1:

Rectangle 2:

Rectangle 3:

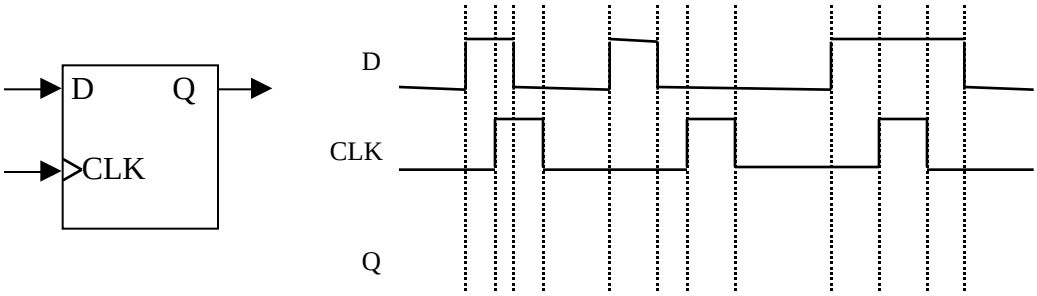
7. For the circuit to the right, what value does Q have? (2 points)



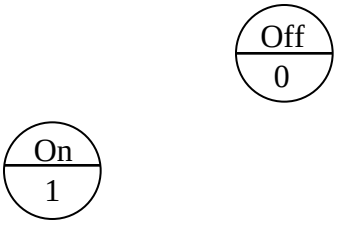
a.) 0 c.) Must know previous value for Q to answer.
b.) 1 d.) Illegal state. Should never have these inputs.

8. In the space to the right, draw the ***decoding logic circuit*** with an ***active-low output*** for the inputs A = 0, B = 0, C = 0, and D = 1. (5 points)

9. Show the D flip-flop output waveform Q based on the inputs D and CLK indicated in the figure below. Assume the flip-flop captures on the rising edge. (6 points)

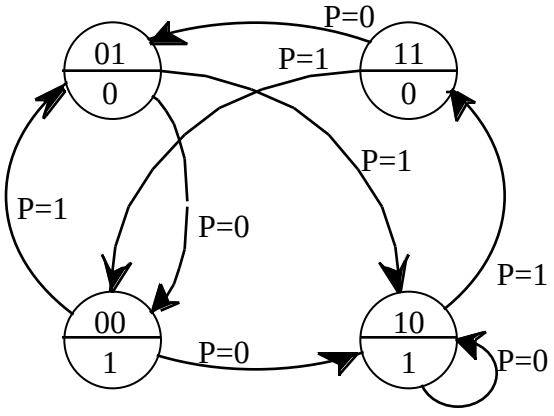


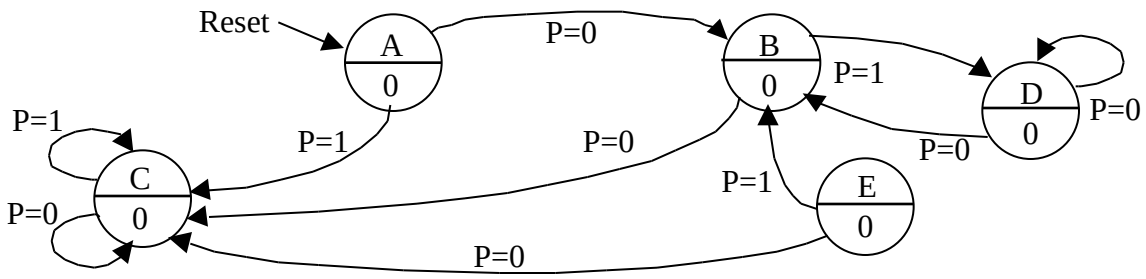
10. The states to the right define the two states of a light bulb. Assume that you have a switch defined as an input S. S=0 should turn the light off and S=1 should turn the light on. Complete the state diagram by drawing ALL of the transitions based on the input S. (4 points)



11. How many latches or flip-flops are needed to realize a state machine with 16 states? (3 points)

12. Create the next state truth table and the output truth table for the state diagram below. Use the variable names S_1 and S_0 to represent the most significant and least significant bits respectively of the binary number identifying the state. (8 points)



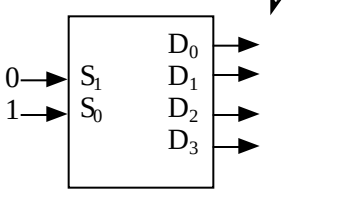


13. Identify the two errors in the above state diagram. Do not bother to correct them. (6 points)

14. The three Boolean expressions below represent the ***next state bits (S_0' and S_1')*** and the ***output bit X*** based on the ***current state (S_0 and S_1)*** and the ***input A***. Draw the logic circuit for the state machine including the flip-flops and output circuitry. Be sure to label flip-flop inputs and other signals. (8 points)

$S_0' = \overline{S}_0 S_1 \overline{A}$ $\quad S_1' = S_0 \overline{S}_1 A$ $\quad X = S_0$

15. For the ***active-low*** output decoder shown to the right, fill in the values for all of the outputs D_0 through D_3. Assume S_1 is most significant bit. (3 points)



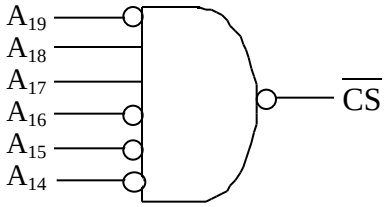
16. When data is passed from the processor to a memory chip, what values do the bus signals $\overline{R}$ and $\overline{W}$ have? (2 points)

a.) $\overline{R} = 0, \overline{W} = 0$ b.) $\overline{R} = 0, \overline{W} = 1$ c.) $\overline{R} = 1, \overline{W} = 0$ d.) $\overline{R} = 1, \overline{W} = 1$

17. For the active low chip selects ^CS1, ^CS2, and ^CS3, what values will they have if the processor is communicating with the memory chip connected to ^CS3? (3 points)

$\overline{CS1}$ = _____ $\overline{CS2}$ = _____ $\overline{CS3}$ = _____

18. What are the high and low addresses (in hexadecimal) of the memory range defined with the chip select shown to the right? (6 points)



Low address: _____ High address: _____

19. For the chip select in problem 18, how big is the memory space for this processor? (3 points)

20. For the chip select in problem 18, how big is the memory chip that uses this chip select? (3 points)

21. True or false: A single memory space can have a low address of $A600_{16}$ and a high address of $AFFF_{16}$. (2 points)

22. True or false: A 1K memory chip can have a low address of $5C00_{16}$. (2 points)

23. True or false: The same chip select should work regardless of the number of data lines connecting the processor to the memory chip. (2 points)

24. Using logic gates, design a chip select for a 2K RAM placed in a 64K memory space with a low address of 3800_{16}. ***Label all address lines used for chip select.*** (7 points)