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 Fall 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
2^{20}	1M
2^{30}	1G

"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. True or False: If done properly, there is exactly one possible arrangement for the rectangles of ones in a Karnaugh map. (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 8 cells? (2 points)

3. True or False: In order to keep a Karnaugh map in 2-dimensions, i.e., so that it can be written on a piece of paper, we are limited to 4 input variables. (2 points)

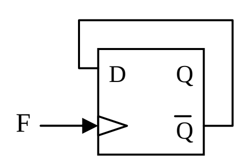
4. Create a Karnaugh map from the truth table below. Do not worry about making the rectangles. (5 points)

A	B	C	X
0	0	0	0
0	0	1	1
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	0
1	1	1	0

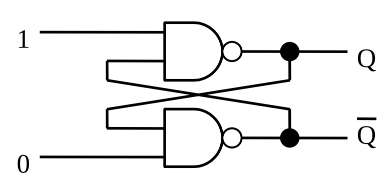
5. Derive the minimum SOP expression from the Karnaugh map below. (6 points)

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

6. The circuit shown to the right was discussed in class and had a special application for digital circuits. What was that application? Hint: F is a periodic clock signal. (2 points)



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.

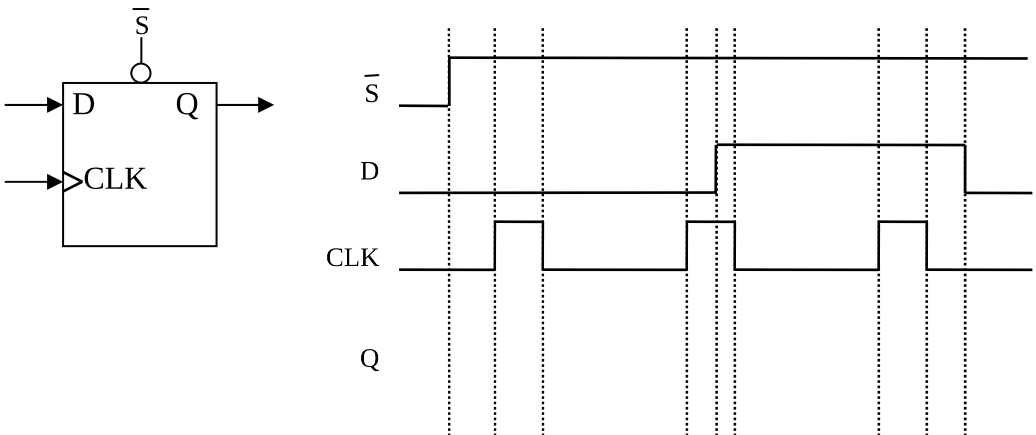
8. True or False: For the circuit in the previous problem, if the inputs changed from 1-0 (the values shown) to 1-1, the value of Q would remain unchanged. (2 points)

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

10. In a truth table, the symbol ↑ indicates that the input is: (2 points)

    a.) a logic 0
    b.) a logic 1
    c.) changing from a 1 to a 0
    d.) changing from a 0 to a 1
    e.) this is an output symbol, not an input
    f.) a "don't care"

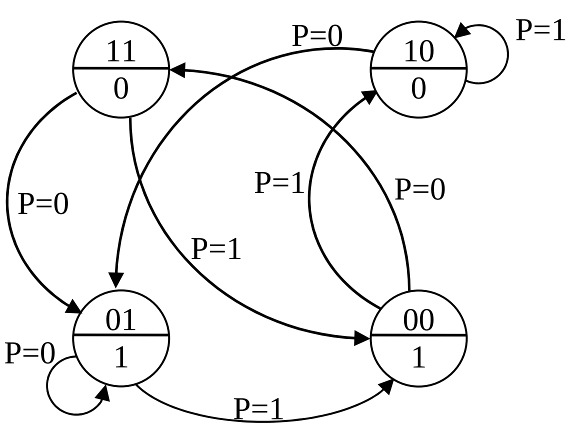
11. Show the D flip-flop output waveform Q based on the inputs D and CLK indicated in the figure below. Assume the flip-flop captures on the rising edge. (6 points)



12. What does the term ***active low*** mean? (3 points)

13. How many latches or flip-flops are needed to realize a state machine with 34 states? (3 points)

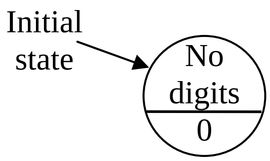
14. Create the next state truth table and the output truth table for the state diagram below. Use the variable names S_1 and S_0 to represent the most significant and least significant bits respectively of the binary number identifying the state. (8 points)



15. Make the state diagram that will output a ‘1’ when the sequence ‘110’ is detected in a serial stream of bits, D. For example, if the following binary stream is received:

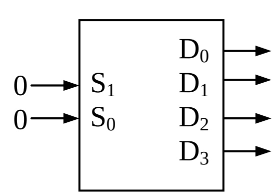
`0 0 1 0 1 1 1 1 0 0 1 1 0 0 0 0 1 1 1 1 1 1 0 1 0 0 1`

then 1’s will be output here. Otherwise, the system will output zeros. (7 points)



16. 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) $S_0' = \overline{A}$ $S_1' = S_1\overline{A}$ $X = S_0S_1$

17. 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)



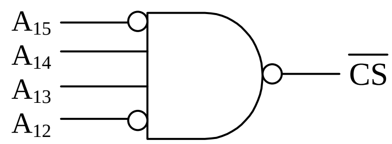
Fill in the ones and zeros for each of these outputs.

18. How many D latches or flip-flops are contained in a RAM memory that has 20 address lines and 8 data lines? (Don't do the calculation; only write the equation with the correct values.) (3 points)

19. Select the invalid setting (if any) of the memory bus signals $\overline{R}$ and $\overline{W}$? (2 points)

a.) $\overline{R} = 0, \overline{W} = 0$ b.) $\overline{R} = 0, \overline{W} = 1$ c.) $\overline{R} = 1, \overline{W} = 0$ d.) $\overline{R} = 1, \overline{W} = 1$ e.) None

20. 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: _______________________

21. For the chip select in problem 20, how big is the memory space for this processor? (3 points)

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

23. What is the largest memory that can have a starting (lowest) address of 16000_{16}? (3 points)

24. How many 16K memories can be placed (without overlapping) in the memory space of a processor that has 24 address lines? (3 points)

25. True or false: A 16K memory and a 4 Meg memory can be connected at the same time to the same address bus of a processor with a memory space of 16 Meg. (2 points)

26. Using logic gates, design an active low chip select for a RAM placed in a 4 Meg memory space with a low address of 30000_{16} and a high address of $37FFF_{16}$. ***Label all address lines used for chip select.*** (7 points)