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, 2004

Section 201

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

2. What is the largest number of input variables a Karnaugh map can handle and still remain 2-dimensional? (2 points) _____

3. In a 3-variable Karnaugh map, how many input variables, A, B, or C, does a product have if its rectangle of 1's contains 2 cells? Your answer should be 0, 1, 2, or 3. (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	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

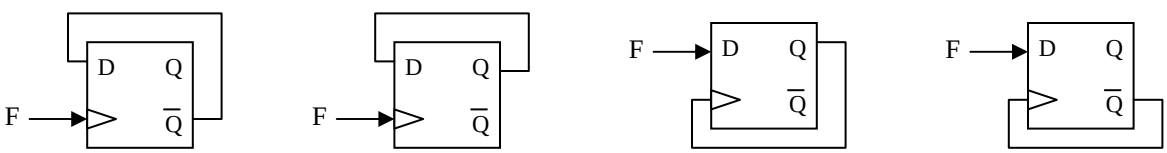
5. In the Karnaugh map to the right, draw the best pattern of rectangles you can. ***Do not derive the SOP expression.*** (4 points)

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

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

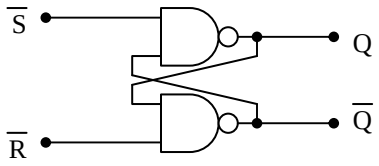
AB \ ***CD***	00	01	11	10
00	1	1	0	0
01	1	1	0	0
11	0	1	1	0
10	0	1	1	1

7. Place a circle around the circuit below that can be used to divide the ***frequency*** of the input F by 2. (3 points)



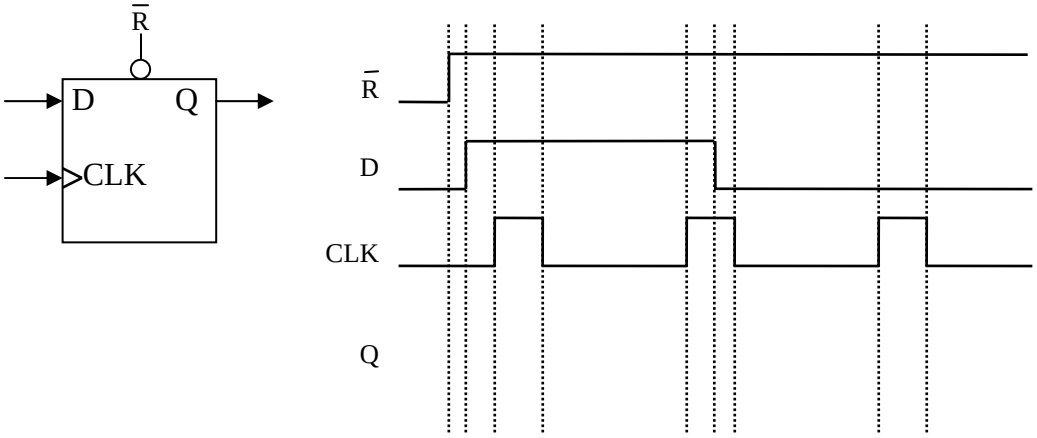
8. Fill out the truth table to the right for all possible combinations of inputs for the circuit below. (5 points)

$\overline{S}$	$\overline{R}$	Q	$\overline{Q}$



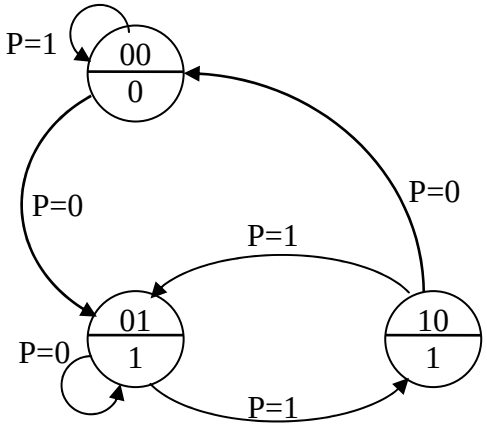
9. In the space to the right, draw the ***decoding logic circuit*** with an ***active-low output*** for the inputs A = 1, B = 1, C = 0, and D = 0. (5 points)

10. 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)

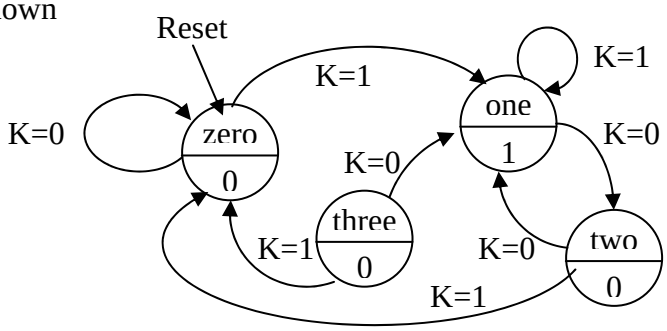


11. How many latches or flip-flops are needed to realize a state machine with 16 states? (3 points)

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 error in the state diagram shown to the right. (3 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) $S_0' = \overline{A} \cdot S_0$ $S_1' = \overline{S_1} \cdot A$ $X = S_0 + S_1$

15. Draw a line between the memory type on the left and its most appropriate characteristic on the right. (10 points)

SRAM ○	○ must be refreshed continuously or data will disappear
EEPROM ○	○ is erased with UV light through a window
DRAM ○	○ best ROM for ***extremely*** large quantities (5,000 or more)
EPROM ○	○ is commonly used in digital cameras and MP3 players
Flash RAM ○	○ best ROM for ***moderate*** quantities (1,000 to 5,000)
OTPROM ○	○ is commonly used for RAM caches
Custom masked ROM ○	○ can be written to by the processor, but has a ***very*** slow

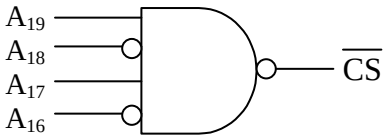
write time as compared to RAM

16. 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)

17. Which of the following settings of the memory bus signals $\overline{R}$ and $\overline{W}$ occurs when the processor is storing data to memory? (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

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 chip that uses this chip select? (3 points)

20. What is the largest memory that can have a starting (lowest) address of $2D000_{16}$? (3 points)

21. 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)

22. True or false: The address range $C000_{16}$ to $DFFF_{16}$ is a valid range for a single memory. (2 points)

23. Using logic gates, design an active low chip select for a RAM placed in a 1 Meg memory space with a low address of 18000_{16} and a high address of $1BFFF_{16}$. ***Label all address lines used for chip select.*** (7 points)