Points missed: _____ Student's Name: _____

Total score: _____/100 points

East Tennessee State University -- Department of Computer and Information Sciences
CSCI 2150 – Computer Organization
TEST 2 for Fall Semester, 2001
Instructor: David Tarnoff

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 blanks provided. Failure to do so will result in no credit for answer.
- **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:

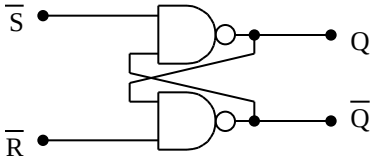
ETSU Policy No. 3.13, October 1, 1979:

"All students in attendance at East Tennessee State University are expected to be honorable."

"Academic misconduct will be subject to disciplinary action. Any act of dishonesty in academic work constitutes academic misconduct. This includes plagiarism, the changing or 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" for the course, reprimand, probation, suspension, and expulsion. For a second academic offense, the penalty is permanent expulsion."

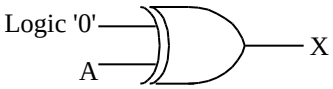
1. Fill out the truth table to the right for all possible combinations of inputs for the circuit below. (5 points)

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



2. Fill in the truth table for the XOR circuit shown to the right. (3 points)

A	X

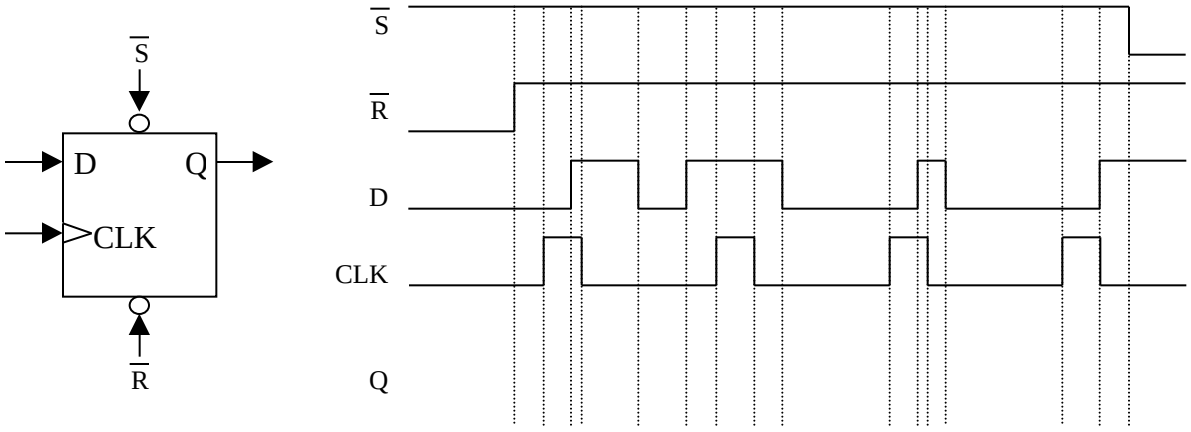


3. True or false: The D flip-flop with inputs CLK and D has no invalid states. (3 points)

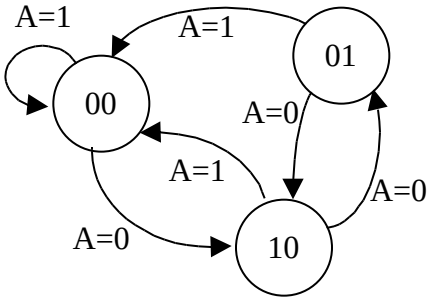
4. How many D flip-flops are contained in an 8-bit RAM with 16 address lines? (4 points)

5. In a truth table, the symbol ↑ indicates that the input is: (3 points)
   a.) a logic 0 c.) changing from a 1 to a 0 e.) this is a symbol for an output, not an input
   b.) a logic 1 d.) changing from a 0 to a 1 f.) a "don't care"

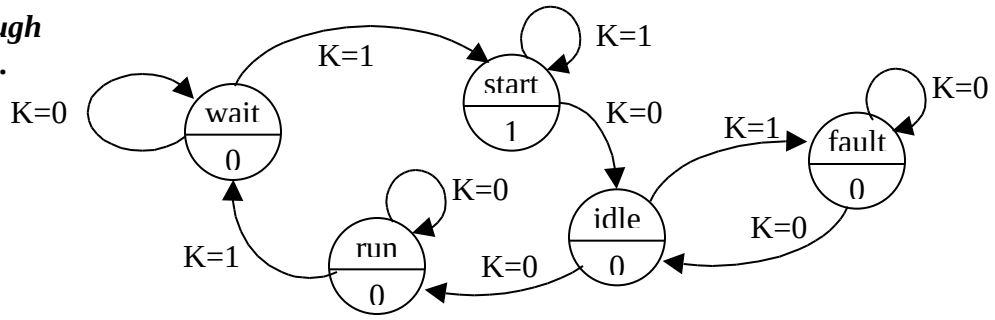
6. Show the D flip-flop output waveform Q for the inputs $\overline{S}$, $\overline{R}$, D and CLK indicated in the figure below. Assume the flip-flop captures on the rising edge. (10 points)



7. Create the next state 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)



Questions 8 through 11 use this figure.



8. If the current state is "run" and the input, K, equals 1, what is the next state? (3 points)

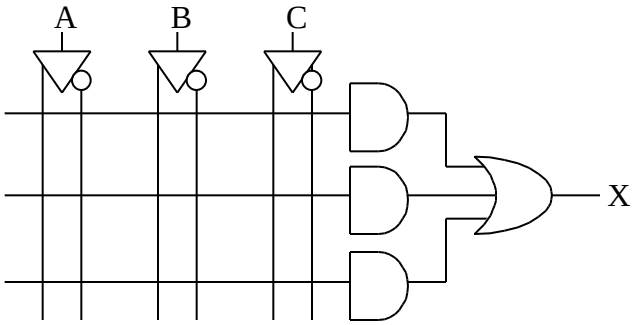
9. If the current state is "start" and the input, K, equals 0, what is the system's current output? (3 points)

10. Identify the error in this state diagram? Be as specific as you can. (4 points)

11. How many flip-flops would it take to realize this state machine? (4 points)

12. Using the shorthand notation, set the PAL diagram to the right to represent the boolean expression: (4 points)

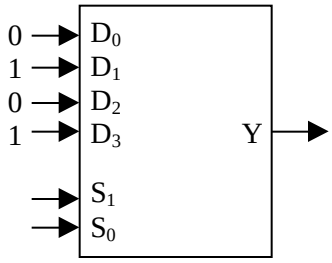
$$X = \overline{A}\, B\, \overline{C} + \overline{A}\, \overline{B}\, C + \overline{C}$$

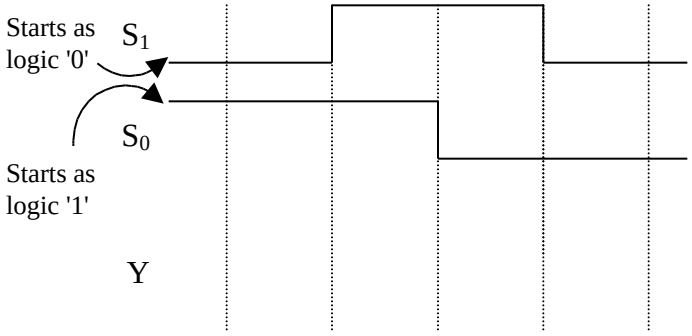


13. The three Boolean expressions below represent the next state bits (S_0' and S_1') and the output bit (X) based on the current state (S_0 and S_1). Draw the logic circuit for the state machine including the flip-flops and output circuitry. Be sure to label flip-flop inputs and other signals. (10 points):

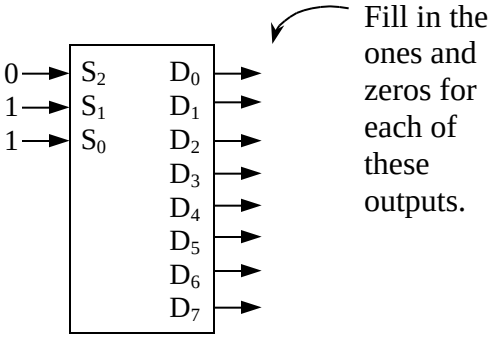
$$S_0' = S_0\overline{S_1} \qquad S_1' = \overline{S_1} \qquad X = \overline{S_0}S_1$$

14. For the multiplexer/selector shown to the right, sketch the output waveform Y for the inputs S_0 and S_1 shown in the graph below. Assume S_1 is the most significant bit. (6 points)





15. For the ***active-low*** output decoder shown to the right, fill in the values for all of the outputs D_0 through D_7. Assume S_2 is most significant bit. (4 points)



16. Circle ***all*** that apply. A storage cell in a SRAM: (4 points)
    a.) is volatile b.) is a capacitor c.) is cheaper than cells in a DRAM
    d.) is a D flip-flop e.) must be refreshed regularly f.) is smaller than cells in a DRAM

17. Circle ***all*** the memory types below can ***only*** be written to with a programmer. (4 points)
    a.) SRAM b.) Flash RAM c.) EPROM
    d.) EEPROM e.) OTPROM f.) DRAM

18. Which of the following is best for very high volumes of product to store code in? (3 points)
    a.) Battery-backed SRAM b.) Flash RAM c.) Custom-masked ROM
    d.) EEPROM e.) OTPROM f.) EPROM

19. Which of the following can be used like a miniature solid-state hard drive? (3 points)
    a.) SRAM b.) Flash RAM c.) Custom-masked ROM
    d.) EEPROM e.) OTPROM f.) EPROM

20. True or False: One memory block can have a low address of $AC00_{16}$ and a high address of $AFFF_{16}$? (4 points)

21. Using logic gates, design a chip select for a 128K RAM placed in a 4 MEG memory space with a low address of 380000_{16}. ***Label all address lines used for chip select.*** (8 points)