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 Spring Semester, 2002
Instructor: David Tarnoff

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 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:

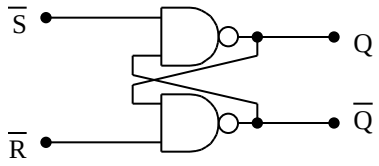
ETSU Policy No. 3.13, October 1, 1979:

"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)

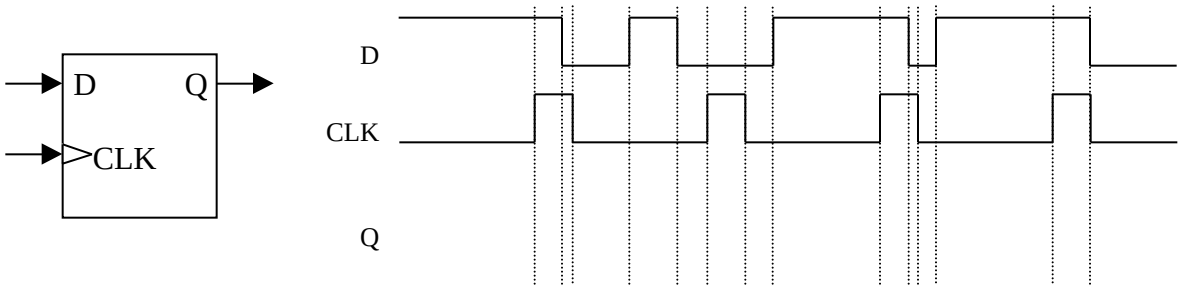
$\overline{S}$	$\overline{R}$	Q	$\overline{Q}$



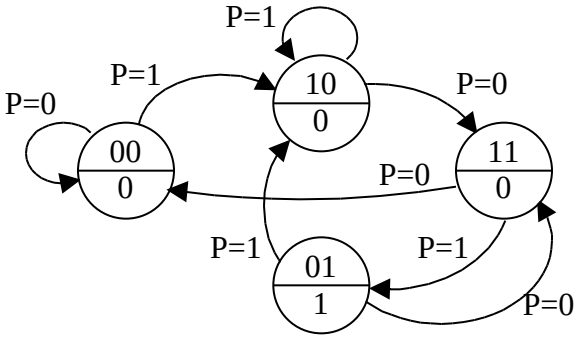
2. In a truth table, the symbol ↑ indicates that the input is: (3 points)

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

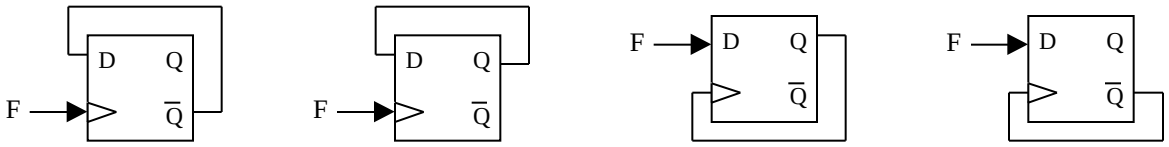
3. Show the D flip-flop output waveform Q based on the inputs D and CLK indicated in the figure below. Assume the flip-flop captures on the rising edge. (6 points)



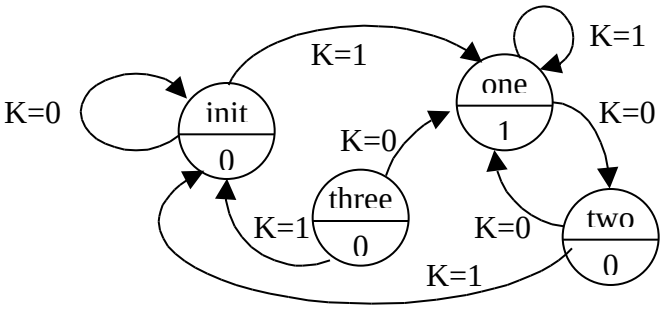
4. Create the next state truth table and the output truth table for the state diagram below. Use the variable names S_1 and S_0 to represent the most significant and least significant bits respectively of the binary number identifying the state. Assume the states have been numbered A=0, B=1, C=2, and D=3. (8 points)



5. Which of the following circuits can be used to divide the ***frequency*** of the input F by 2? (3 points)



6. Assuming the state the machine ***always*** begins in "init", identify the error in this state diagram? Be as specific as you can. (4 points)

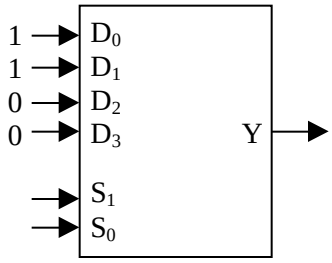


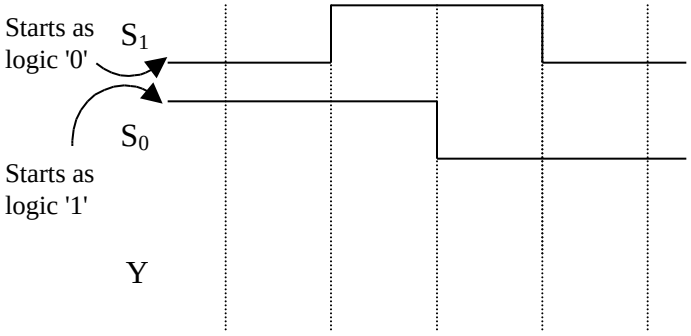
7. What is the minimum number of flip-flops it would take to realize a state machine with 42 states? (4 points)

8. 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. (8 points):

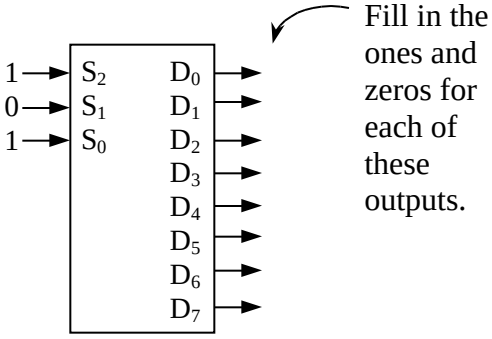
$$S_0' = S_0 + \overline{S_1} \qquad S_1' = \overline{S_1}S_0 \qquad X = \overline{S_0}S_1 + S_0\overline{S_1}$$

9. 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)





10. 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. (3 points)



11. How many D flip-flops are contained in a 16-bit RAM with 24 address lines? (Don't do the calculation; only write the equation with the correct values.) (4 points)

12. Why is a cache RAM smaller than a regular RAM? (4 points)

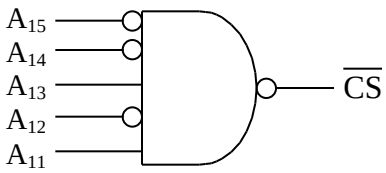
13. Draw a line between the memory type on the left and its most appropriate characteristic on the right. (2 points each)

EEPROM	○	○	must be refreshed continuously or data will disappear
SRAM	○	○	is erased with UV light through a window
Flash RAM	○	○	best for ***extremely*** large quantities (more than 10,000)
DRAM	○	○	data is stored in D flip-flops
EPROM	○	○	can only be programmed once by a programmer
OTPROM	○	○	can be used like a miniature solid-state hard drive
Custom masked ROM	○	○	can be written to by the processor, but has a very slow write time as compared to RAM

14. True or False – A DRAM is more expensive than an SRAM of the same size. (3 points)

15. True or False – A DRAM has higher densities than an SRAM. (3 points)

16. What are the high and low addresses of the memory range defined with the chip select shown to the right? (4 points)



Low address: _____ High address: _____

17. For the chip select in problem 16, how big is the memory chip that uses the chip select? (3 points)

18. How many 128K memories can be fit into the memory space of a microprocessor with 27 address lines? (3 points)

19. True or false: A single memory space can have a low address of 2500_{16} and a high address of $27FF_{16}$. (3 points)

20. True or false: A 2K memory chip can have a low address of $A9800_{16}$. (3 points)

21. Using logic gates, design a chip select for an 8K RAM placed in a 128K memory space with a low address of 6000_{16}. ***Label all address lines used for chip select.*** (6 points)