

NOTE: It is my policy to give a failing grade in the course to any student who either gives or receives aid on any exam or quiz.

INSTRUCTIONS: Answer multiple choice questions by circling the letter of the best choice available. Answer questions 11 and 14 in the spaces provided. Draw diagrams on the backs of the question sheets. Be sure to write the question numbers next to your diagrams.

1. (5 Points) Define *propagation delay*.
 - A. The number of wires going into a gate.
 - B. The number of wires going out of a gate.
 - C. The number of gates in a logic network.
 - D. The time it takes to add two numbers.
 - E. The time it takes a gate to change state.
2. (5 Points) What is the frequency of a clock that has a period of 200 nanoseconds?
 - A. 5 MHz
 - B. 8 MHz
 - C. 5 GHz
 - D. 8 GHz
 - E. 200,000 picoseconds.
3. (5 Points) What is the period of a 4 GHz clock?
 - A. 250 picoseconds
 - B. 250 nanoseconds
 - C. 250 microseconds
 - D. 250 milliseconds
 - E. 0.25 Hz.
4. (5 Points) How many picoseconds are there in one microsecond?
 - A. 1,000
 - B. 1,000,000
 - C. 1,000,000,000
 - D. 0.001
 - E. 0.000,001
5. (5 Points) To convert milliseconds to microseconds, multiply the number of milliseconds by:
 - A. 1,000
 - B. 1,000,000
 - C. 1,000,000,000
 - D. 0.001
 - E. 0.000,001
6. (5 Points) What is the prefix for 2^{30} ?
 - A. Kilo or kibi
 - B. Mega or mebi
 - C. Giga or gibi
 - D. Nano or nini
 - E. Peta or piti
7. (5 Points) What is the prefix for 2^{20} ?
 - A. Kilo or kibi
 - B. Mega or mebi
 - C. Giga or gibi
 - D. Nano or nini.
 - E. Peta or piti

8. (5 Points) What is the decimal value of the two's complement number 1111111111111111101₂?
- A. 111,111,111,111,111,101
 - B. -5
 - C. -3
 - D. 358,627,402
 - E. 358,627,403
9. (5 Points) What is the minimum number of *binary* (yes/no) questions would you have to ask someone to find out what day their birthday is?
- A. 1
 - B. 9
 - C. 43
 - D. 365
 - E. 366
10. (5 Points) Which is the best definition of *overflow*?
- A. When the carry in is the same as the carry out.
 - B. When the result can't be represented in the number of bits available.
 - C. When the carry out of the leftmost position is 1.
 - D. When the carry into the rightmost position is 1.
 - E. When the answer is negative.

11. (5 Points) Complete the Karnaugh Map for this truth table, and give the equation for the minimized function.

a	b	c	Y
0	0	0	1
0	0	1	1
0	1	0	0
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	0
1	1	1	1

a \ bc	00	01	11	10
0				
1				

12. (10 Points) Draw the gates to implement a D flip-flop. Be sure to label all inputs and outputs meaningfully.
13. (20 Points) Draw a *state diagram*, a *state table*, and a *circuit diagram* for the following finite state machine: There are four states named *State_0*, *State_1*, *State_2*, and *State_3*. There is an external input called X and an external output called Y. Y is true whenever the machine is in *State_0* or *State_2*, and false otherwise. When X is false, clock pulses take the machine through the states in the sequence 3, 2, 1, 0, 3, When X is true, the FSM does not change state.
14. (20 Points) Fill in the table below for the four-bit version of the MIPS ALU that we designed in class. Everything given is in binary, and your answers are to be in binary too. C is Carry, V is oVerflow, and Z is Zero.

A	B	F	A'	B'	Result	C	V	Z
0000	0001	0111						
1010	1110	0010						
0101	0110	0110						
0011	0101	0000						
0101	0011	0001						
0011	1010	0110						