

Instructions:

- Be sure your name is on your Scantron answer sheet and that the Exam ID on the answer sheet matches the Exam ID above.
- Answer multiple choice questions on your Scantron sheet. Answer questions that require diagrams on the back of the exam sheets.

Note: It is my policy to give a failing grade in the course to anyone who gives or receives unauthorized aid on any exam or quiz.

1. Did you read the instructions at the top of this page? Answer A for “yes.”
2. What is the best definition of propagation delay?
 - A) The time from the beginning of one pulse to the beginning of the next one.
 - B) The time it takes a gate to change state after an input changes.
 - C) The number of pulses in one second.
 - D) The time it takes to answer one binary question.
 - E) The amount of uncertainty reduced by answering one binary question.
3. What is the best definition of clock period? (Same Choices as Question 2.)
4. What is the best definition of clock frequency? (Same Choices as Question 2.)
5. What is the best definition of bit? (Same Choices as Question 2.)
6. A program executes a mix of different instruction types. 25% of the instructions require two clock cycles to execute, 20% require 3 clock cycles to execute, 5% require 4 clock cycles, and the remainder all require just one clock cycle to execute. What is the average number of clock cycles per instruction?
 - A) 1.6
 - B) 1.8
 - C) 2.0
 - D) 2.2
 - E) 2.4
7. To run a program, computer with a 1.0 GHz clock speed executes 10^9 instructions with an average of 3.0 clock cycles per instruction. How long does it take this computer to run this program?
 - A) 3.0 seconds
 - B) 3.0 Hz
 - C) 3.0 Gigabytes
 - D) 3.0 KiloHertz
 - E) 3.0 KiloSeconds
8. Computer A requires 10 seconds to execute a program, and Computer B requires 12 seconds to execute the same program. Which statement best describes the relative speeds of the two computers?
 - A) Computer A is 10 times faster than Computer B.
 - B) Computer A is 12 times faster than Computer B.
 - C) Computer A is 50% faster than Computer B.
 - D) Computer A is 20% faster than Computer B.
 - E) Computer A is 10% faster than Computer B.

9. An audio file contains 60 seconds of music, which was recorded at a 20KHz sampling rate in stereo. Both channels were recorded at 12 bits per channel per sample. How big is the file?
- A) 28.8 Megabits
 - B) 28.8 Gigabits
 - C) 38.4 Megabits
 - D) 38.4 Gigabits
 - E) 4800 KHz
10. What is the range of two's complement values that can be encoded using 12 bits?
- A) 0 to $2^{12}-1$
 - B) 0 to $2^{11}-1$
 - C) -2^{12} to 0
 - D) -2^{11} to -1
 - E) -2^{11} to $2^{11}-1$
11. Can the decimal value +12 be represented as a 5-bit two's complement number?
- A) Yes
 - B) No
12. Can the decimal value -60 be represented as a 5-bit two's complement number?
- A) Yes
 - B) No
13. What will be the condition code settings if the 4-bit two's complement values 0011_2 and 0111_2 are added to produce a 4-bit sum?
- A) C, V, N, and Z will all be true.
 - B) C, V, N, and Z will all be false.
 - C) Only C, V, and N will be true.
 - D) Only C and V will be true.
 - E) Only V and N will be true.
14. What is the 6-bit two's complement representation of -21?
- A) 101000_2
 - B) 101001_2
 - C) 101010_2
 - D) 101011_2
 - E) 101100_2
15. Which statement is true about the difference between combinational logic circuits and sequential logic circuits?
- A) Combinational circuits combine the inputs and the outputs, but sequential circuits combine the outputs only after generating the inputs.
 - B) Combinational circuits are more complicated than sequential circuits.
 - C) Combinational circuits have feedback, but sequential circuits do not.
 - D) If you know the values of the inputs to a combinational circuit, you can tell what the outputs must be, but a sequential circuit can have different outputs for the same set of input values.
 - E) Combinational circuits are edge triggered, but sequential circuits are level sensitive.

16. What is the difference between a latch and a flip-flop?
- A) A latch can change state only once per clock cycle, but a flip-flop can change state multiple times during a clock pulse.
 - B) A flip-flop can change state only once per clock cycle, but a latch can change state multiple times during a clock pulse.
 - C) A latch can change state only when the clock is false, but a flip-flop can change state when the clock is either true or false.
 - D) A flip-flop can change state only when the clock is true, but a latch can change state when the clock is either true or false.
 - E) A latch is used to build combinational circuits, but a flip-flop is used to build sequential circuits.
17. A “majority function” is true if more than half of its inputs are true. Construct the truth table for a majority function with 4 inputs. (The function is true only if if three or more inputs are true.) Minimize the function using a Karnaugh Map, and draw a circuit diagram that implements your minimized function. Be sure to label all inputs and outputs meaningfully. Answer below or on the back of any exam sheet. Be sure to write the question number (17) next to your answer.
18. Draw all the gates to build a clocked D latch (not a flip-flop). Label all inputs and outputs meaningfully. Answer below on the back of any exam sheet. Be sure to write the question number (18) next to your answer.
19. Draw a state diagram (circles and arcs) for a 3 bit down counter. Give the states names like “State_n” where n is the numerical value of the three state flip-flops. State_0 is followed by State_7; State_1 is followed by State_0; State_2 is followed by State_1, etc. Construct a state table that shows the behavior of this state machine. Be sure to label the present state and next state groups of columns meaningfully. Minimize all three flip-flop input functions using Karnaugh Maps, and draw a complete circuit diagram for your state machine. Use standard symbols for each flip-flop (be sure to use the symbol for flip-flops, not latches), and draw the individual gates for the other parts of the circuit. Answer below or on the back of any exam sheet. Be sure to write the question number (19) next to your answer.