

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: Circle the letter of the best choice for each multiple choice question. For diagram questions, draw the diagram on the back of any exam sheet. Be sure to write the question number next to each diagram. Except where otherwise indicated, all questions count equally. USE PENCIL IF YOU HAVE ONE.

1. (4 Points) What is the preferred instrument to use for answering questions on this exam?
 - A. Pencil
 - B. Pen
 - C. Crayon
 - D. Paint
 - E. Charcoal
2. (4 Points) What type of gate will produce a value of *true* if its inputs are different from each other?
 - A. AND
 - B. OR
 - C. NAND
 - D. NOR
 - E. XOR
3. (4 Points) What single gate could be used to detect overflow during two's complement addition or subtraction?
 - A. AND
 - B. OR
 - C. NAND
 - D. NOR
 - E. XOR
4. (4 Points) What is the decimal value of the 16 bit two's complement number 0xFFFF?
 - A. 65,634
 - B. 0
 - C. -1
 - D. -2
 - E. +3
5. (4 Points) What is the smallest number of flip-flops that could be used to build a finite state machine that has a clock with a period of one day and that keeps track of the day of the week?
 - A. 0
 - B. 1
 - C. 3
 - D. 6
 - E. 7
6. (4 Points) In a finite state machine, the present state is given by which of the following:
 - A. The D outputs of the flip-flops
 - B. The Q outputs of the flip-flops
 - C. The D inputs of the flip-flops
 - D. The D outputs of the flip-flops
 - E. The clock inputs of the flip-flops
7. (4 Points) In a finite state machine, state transitions happen only:
 - A. When there is a clock pulse
 - B. When the present state is the same as the next state
 - C. When the present state causes the next state to reset
 - D. When the reset causes a clock pulse on the D outputs of the flip-flops
 - E. When the latches cause the Q inputs of the flip-flops to toggle

8. (4 Points) In a finite state machine, the outputs of the combinational logic go to
- A. The clock generator
 - B. The latch outputs
 - C. The condition code bits
 - D. The pushbuttons
 - E. The D inputs of the flip-flops
9. (4 Points) How many flip-flops are there in a 32-bit parallel adder?
- A. 0
 - B. 32
 - C. 64
 - D. 96
 - E. 128
10. (4 Points) What limits the maximum rate at which the clock of a finite state machine can be operated?
- A. The number of inputs to the combinational logic
 - B. The number of outputs from the combinational logic
 - C. The number of flip-flops
 - D. The propagation delays in the combinational logic
 - E. The number of latches in the combinational logic
11. (4 Points) Draw the Karnaugh Map for the following function and write the minimized equation:
- | a | b | c | Y |
|---|---|---|---|
| 0 | 0 | 0 | 0 |
| 0 | 0 | 1 | 1 |
| 0 | 1 | 0 | 1 |
| 0 | 1 | 1 | 0 |
| 1 | 0 | 0 | 1 |
| 1 | 0 | 1 | 1 |
| 1 | 1 | 0 | 1 |
| 1 | 1 | 1 | 1 |
12. (4 Points) A disk is rotating at 7200 RPM. How long does it take to make one complete revolution?
- A. 8.3 seconds
 - B. 8.3 milliseconds
 - C. 83 milliseconds
 - D. 8.3 microseconds
 - E. 83 microseconds
13. (4 Points) What is the frequency of a clock with a period of 500 picoseconds?
- A. 0.00000000500 seconds
 - B. 500 GHz
 - C. 2 GHz
 - D. 0.5 nanoseconds
 - E. 42
14. (4 Points) What bandwidth is required to transmit 30 network requests per second if each request is 64 KB (kilobytes) on average? (Pick the closest answer.)
- A. 2 kilobytes per second
 - B. 16 kilobytes per second
 - C. 2 megabytes per second
 - D. 16 megabytes per second
 - E. 2 gigabytes per second

15. (4 Points) Which of the following is an on/off switch controlled by electricity?
- A. Pushbutton
 - B. Slide switch
 - C. LED
 - D. Seven segment display
 - E. Transistor
16. (4 Points) Segments A, B, and C are on.
- A. F
 - B. 5
 - C. 6
 - D. 9
 - E. 7
17. (4 Points) 0xD
- A. 1101
 - B. 1011
 - C. 0101
 - D. 1100
 - E. 1110
18. (4 Points) What is the name of the logic circuit that would be used to control which of two signals would be passed to another part of a design? (The one we used for selecting the fast or slow clock signal in the calendar state machine, for example.)
- A. Full adder
 - B. Half adder
 - C. Decoder
 - D. Multiplexer
 - E. Flip-flop
19. (4 Points) Draw the symbol for the circuit in Question 18.
20. (4 Points) Draw the gates to implement the circuit in Question 18.
21. (8 Points) Draw a circuit diagram showing the logic in the leftmost slice of the ALU designed in the book. Include the logic to generate the condition code values. (Carry, oVerflow, Negative, and Zero; for Zero draw the gate and write a note about where most of the inputs come from.)
22. (4 Points) Put a checkmark next to each combination of Carry and Overflow that is possible when doing two's complement addition or subtraction. Leave impossible combinations blank.

C	V	Possible?
0	0	
0	1	
1	0	
1	1	

23. (4 Points) In Java, C, and C++, $101011 \& 011001 = ?$ (Circle the *best* choice.)
- A. true
 - B. false
 - C. 001001
 - D. 111111
 - E. 110110
24. (4 Points) Draw a timing diagram that shows the behavior of a D flip-flop in response to three clock pulses. The first pulse is to turn the flip-flop on, the second one is to leave it on, and the third one is to turn it off. Include Clock, D, and Q signal lines in your diagram.
25. (4 Points) Draw the symbol for a D flip-flop and add circuitry that will make its state toggle every time there is a clock pulse.