ECE2031 In-Class Exam Fall 2006

ANSWER SHEET

Name _____ **Section** _____ **Student No.** _____

Closed Books, Closed Notes, No computers or calculators.

Having read the Georgia Institute of Technology Academic Honor Code, I understand and accept my responsibility as a member of the Georgia Tech Community to uphold the Honor Code at all times. In addition, I understand my options for reporting honor violations as detailed in the code.

_____ _____

(Signature) (Date)

CIRCLE YOUR SELECTED ANSWERS OR FILL IN AS NEEDED

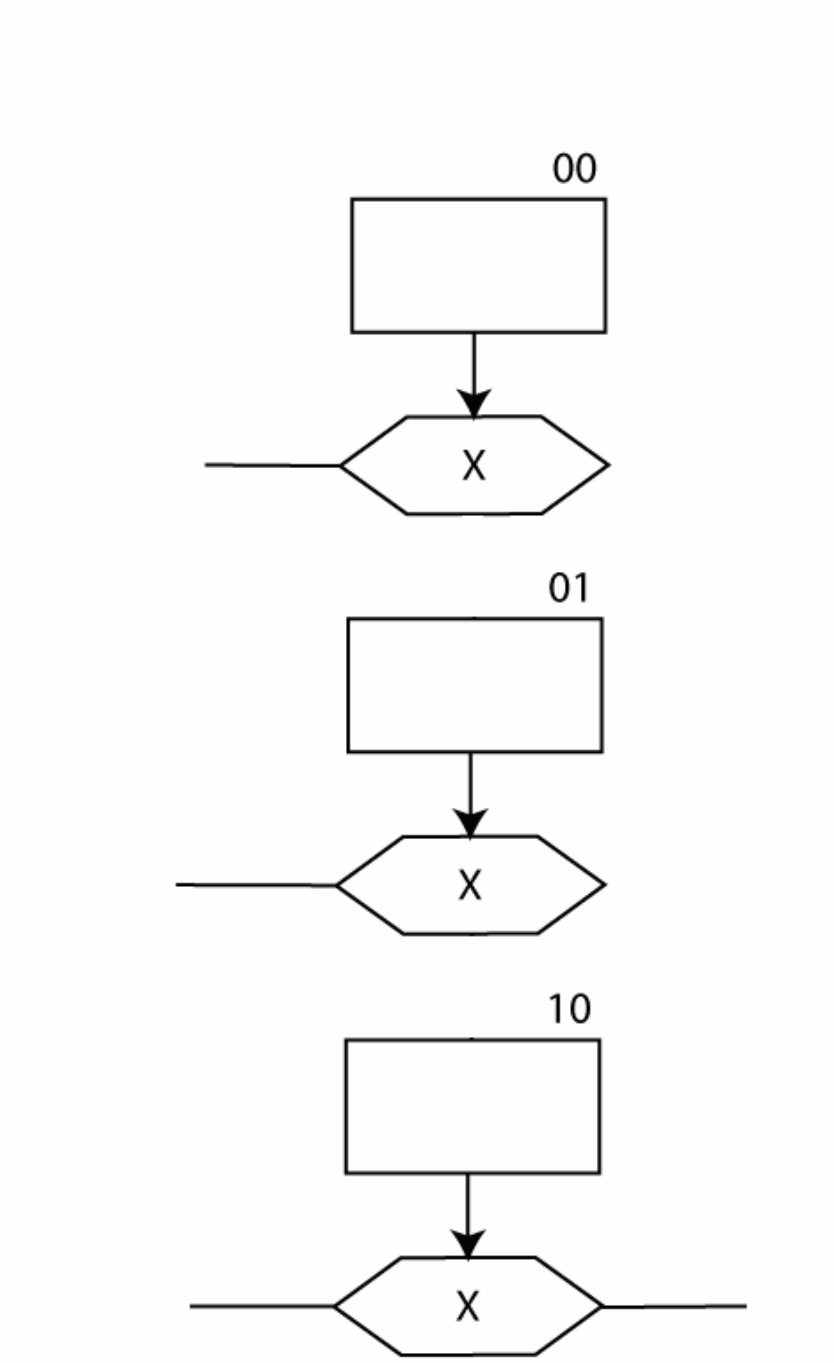
1. a b c d e (5 pts)
2. a b c d e (5 pts)
3. a b c d e (8 pts)
4. a b c d (5 pts)
5. a b c d e (5 pts)
6. a b c (5 pts)
7. a b (5 pts)
8. a b c d (8 pts)
9. a b c d e (8 pts)
10.

AB \ CD	00	01	11	10
00				
01				
11				
10				

(15 pts)

Y=_____

11. (10 pts)



12. a b c d e (5 pts)
13. a b c d e (8 pts)
14. a b c d (8 pts)

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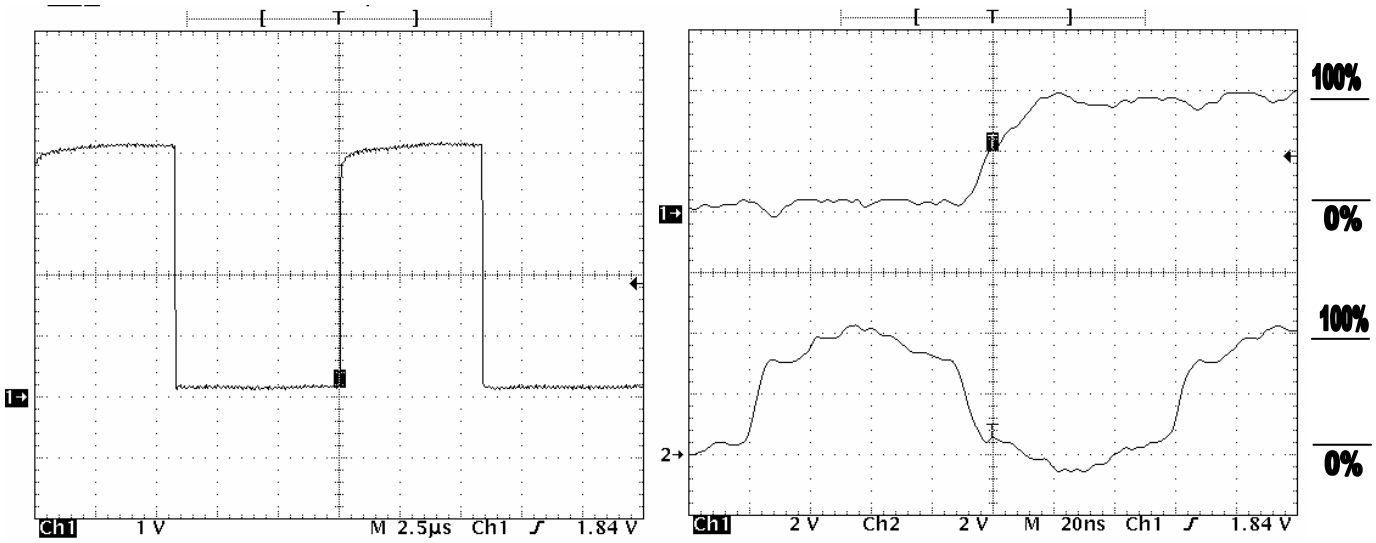
Mark all answers on the answer sheet.

Questions 1-3: The images below show two different signal acquisitions. There is no relation between them, and the respective scales are shown for both time and voltage. You may assume that when the signals *appear* to repeat, they *do* repeat. These do not necessarily show optimal placement and scaling, but they are adequate for the resolution requested for the problems.

FOR THE SIGNALS ON THE RIGHT, there is large overshoot, so you do not have sufficient data to tell where the 0% and 100% levels are (if the signals were allowed to settle). So assume that for both waveforms, 0% is 0.4V and 100% is 3.8V, approximately where the percentage markers are shown on the right.



From these figures, estimate the following parameters:

1. (5 pts) Period of the waveform on the left

   a) 13 ms b) 2.5 us c) 12.7 us d) 15 us e) 2 ns

2. (5 pts) Rise time of the signal on the upper waveform (channel 1) on the right

   a) ~1.84 ns b) ~5 ns c) ~9 ns d) ~19 ns e) ~35ns

3. (8 pts) Propagation delay from the falling edge of channel 2 to the rising edge of channel 1

   a) 2 ns b) 4 ns c) 9 ns d) 20 ns e) 20 ns

4. (5 pts) You have been instructed at times to make sure that Quartus treats unused pins as "input, tri-stated." Why would this matter?

   a) Quartus will connect those unused pins to some of the output pins from your design, and you shouldn't have outputs connected to outputs
   b) Quartus has no special knowledge of the UP3 board other than what you specify, so a design compilation could accidentally drive a pin that may control UP3 devices in an adverse way
   c) Unused pins are always needed as extra inputs
   d) It does not matter, actually.

5. (5 points) If your SCASM.CFG file has the line:

```
ROR &H33%6,  %10
```

And if you have a line in your assembly language program like this:

```
ROR &H0A0
```

…. what machine code, in binary, would be generated for that line?

   a) 0101110000100000
   b) 0000000000000001
   c) 1100110010100000
   d) 0000000001010001
   e) None of the above

6. (5 points) In Lab 3, Appendix G provided information about "propagating values" and "controlling values," which were used to set up test conditions for measuring your worst-case propagation delay. What is the propagating value for an OR gate?

   a) 0
   b) 1
   c) None of the above

7. (5 points) The state machine you constructed for the Train Lab could control whether the power on Track 1 was forward, reverse or off.

   a) TRUE
   b) FALSE

8. (8 points) Given the UP3 and the version of top_scomp (and supporting files) provided most recently for the project, which of the following would be projects that you could do ONLY WRITING code for SCOMP (i.e., without creating new dcvices or modifying SCOMP)? (Select all that apply)

   a) A timer that starts at some fixed number on the LCD, counts down, and lights an LED, which you could reset with a pushbutton.
   b) A display (on the LCD) of the 4-bit value of the DIP switch, where 0 is switch-down, and 1 is switch-up.
   c) A USB flash reader
   d) A color-bar pattern with 8 colors in 8 vertical bars, each taking up about 1/8 of the width of the VGA screen.

9. (8 points) Which of the following were suggested as debugging techniques? (Select all that apply.)

   a) Maximize use of the user interface (i.e., switches to inject test inputs, displays to show test status)
   b) Sequentially change each line of VHDL code in order until a solution is found
   c) Use unassigned pins on programmable devices as test points, and probe them with test equipment
   d) Start over with entirely different functions
   e) Swap a known-good component for a suspicious one

10. (10 points) Fill in the Karnaugh Map for the following truth table and solve it, circling the prime implicants and writing the minimal sum of products expression.

ABCD	Y
0000	1
0001	0
0010	1
0011	0
0100	1
0101	0
0110	1
0111	0
1000	0
1001	0
1010	0
1011	1
1100	1
1101	0
1110	1
1111	0

11. (10 points) Finish the ASM diagram corresponding to the following transition table. The states have no names, so the names can be left off the ASM diagram. But all necessary transition arrows must be shown (with correct value of X alongside), and Z must be shown in states only where it is asserted (1). USE THE ASM DIAGRAM ON THE ANSWER SHEET and build upon it. It is not necessary to erase any part of what is given there.

Present State			Next State		
Q_1	Q_1	X	Q_1^+	Q_1^+	Z
0	0	0	0	1	0
0	0	1	1	0	0
0	1	0	1	0	1
0	1	1	0	0	1
1	0	0	0	0	1
1	0	1	0	1	1
1	1	0	d	d	d
1	1	1	d	d	d

For the next two questions, consider the following ASM code. Assume this has been assembled and run on SCOMP.

```
         ORG     &H000   ;Begin program at x000

Start:   LOAD    A
         ADD     B
         XOR     C
         SHIFT   -2
         SUB     X
         JZERO   Wait
         LOAD    ZERO
         SUB     D
Done:    JUMP    Done    ;Loop forever

Wait:    LOAD    D
         JUMP    Done


A:       DW      &H000A
B:       DW      &H000B
C:       DW      &H000C
D:       DW      &H000D
X:       DW      64
ZERO:    DW      0
```

12. (5 points) What is the actual address of the storage location labelled “A”?
    a) &H009
    b) &H00A
    c) &H00B
    d) It has no location in memory
    e) Impossible to tell from the information given

13. (8 points) When the instruction labelled “Done” is executed, what is the value of the accumulator (AC)?
    a) &H000D
    b) &HFFF3
    c) &HFFF2
    d) That instruction is never executed.
    e) None of the above.

14. (8 pts) Suppose that you wanted to create an instruction for SCOMP called INV that would take the two's complement of the accumulator, and put the result in the accumulator. Which of the following would most closely accomplish that, assuming that the decode stage correctly transitions to the EX_INV stage for execution?

(AC is accumulator. You must pick the one best answer, even if you think you see a minor error.)

a)
```
WHEN EX_INV =>
     AC <= NOT(AC) + 1;
     STATE <= FETCH;
```

b)
```
WHEN EX_INV =>
     IF AC < 0 THEN
       AC <=  X"0000" - AC;
     END IF
     STATE <= FETCH;
```

c)
```
WHEN EX_INV =>
     IF AC(1) < '0' THEN
       AC <= X"0000" - AC;
     END IF;
     STATE <= FETCH;
```

d)
```
WHEN EX_INV =>
     AC <= NOT(AC);
     STATE <= FETCH;
```