

# ECE2031 In-Class Exam A Spring 2003

## 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)

1.

	A	0	1
BC			
00		1	0
01		1	0
11		1	1
10		1	0

2. a b

Ans: b

3. a b

Ans: b

4. a b c d e

Ans: b

5. a b c d e

Ans: a,d,e

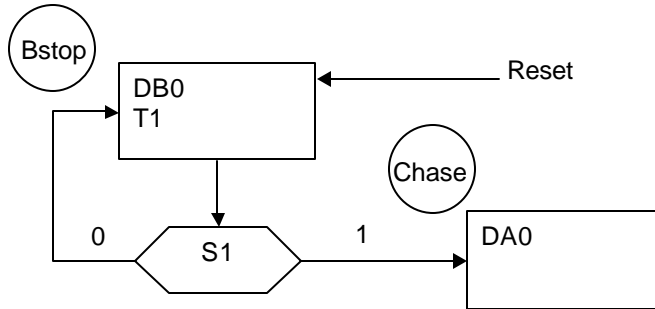
6.

Q1	Q0	X	Q1+	Q0+	Z
0	0	0	1	0	0
0	0	1	0	0	0
0	1	0	1	1	0
0	1	1	0	1	0
1	0	0	1	0	0
1	0	1	0	1	0
1	1	0	0	0	1
1	1	1	0	0	1

7.

SW1	SW2	SW3	SW4
0	0	0	0

8.



Indicate all outputs that are nonzero (inside the state box), except for SW1-4.  
 Fill in the underlined values for S1.  
 Add any necessary transitions or inputs.

9. a b c d e Ans: d

10. a b c d e Ans: d

11. a b c d e Ans: b

12. a b Ans: a

13. Fill in one of the following letters in each of the empty boxes, relative to code below.
- a) Positive edge-triggered D flip-flop with synchronous reset
  - b) Positive edge-triggered D flip-flop with asynchronous reset
  - c) Counter
  - d) Moore state machine
  - e) Multiplexer

Code Segment	1	2	3	4	5
Function (a-e)					

14. Make corrections in code below

### CODE SEGMENT 1

```

PROCESS
BEGIN
    WAIT UNTIL (clock'EVENT & clock = '1');
    IF reset = '1' THEN
        Q2 <= '0';
    ELSE
        Q2 <= d;
    END IF;
END PROCESS; -- hint: an operator is wrong

```

### CODE SEGMENT 2

```

PROCESS(reset, clk)
BEGIN
    I_wish_they_were_all_this_easy;
    IF reset = '1' THEN
        variable <= variable_A;
    ELSIF clk'EVENT AND clk = '1' THEN
        CASE variable IS
            WHEN variable_A =>
                IF input1 = '0' THEN
                    variable <= variable_B;
                ELSE
                    variable <= variable_C;
                END IF;
            WHEN variable_B =>
                variable <= variable_C;
            WHEN variable_C =>
                IF input2 = '1' THEN
                    variable <= variable_A;
                END IF;
            WHEN OTHERS =>
                variable <= variable_A;
        END CASE;
    END IF;
END PROCESS;
WITH variable SELECT
    Output1 <= '0' WHEN variable_A,
              '1' WHEN variable_B,
              '0' WHEN variable_C;

```

### CODE SEGMENT 3

```

PROCESS(reset)
BEGIN
    IF reset = '1' THEN
        Q3 <= '0';
    ELSIF (clock'EVENT AND clock = '1') THEN
        Q3 <= d;
    END IF;
END PROCESS; -- hint: sensitivity

```

### CODE SEGMENT 4

```

count <= temp;
PROCESS(reset, clock)
BEGIN
    IF reset = '1' THEN
        temp <= "00000000";
    ELSIF (clock'EVENT AND clock = '1') THEN
        IF temp < max THEN
            temp <= temp + 1;
        ELSE
            temp <= '00000000';
        END IF;
    END IF;
END PROCESS; -- hint: bits and bytes

```

### CODE SEGMENT 5

```

Device_out <= A;
PROCESS ( A, B, Device_Control)
BEGIN
    IF Device_Control = '0' THEN
        Device_out <= A;
    ELSE
        Device_out <= B;
    END IF;
END PROCESS;
-- (hint: it has to do with the assignment
-- of Device_out.)

```

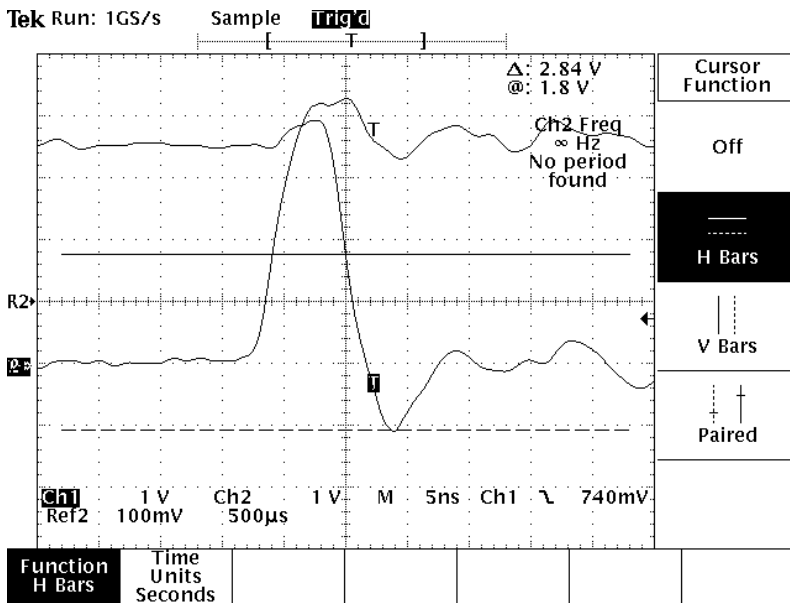
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Mark all answers on the answer sheet.**

1. (10 pts) Fill in the Karnaugh map corresponding to this function. Don't bother with minimizing, circling implicants, etc. Just fill in the map on the answer sheet.

$$F = \bar{A} + ABC$$

2. (5 pts) Is the function F in problem 1 in its minimal sum of products form?  
 a) YES  
 b) NO
3. (5 pts) The IR detector used in the project returns a value of FF (hex) if no beacons are detected.  
 a) TRUE  
 b) FALSE
4. (5 pts) A hardcopy of an oscilloscope screen is shown below. Note that the ground for both signals is at the same point (three full divisions up from the bottom of the screen).



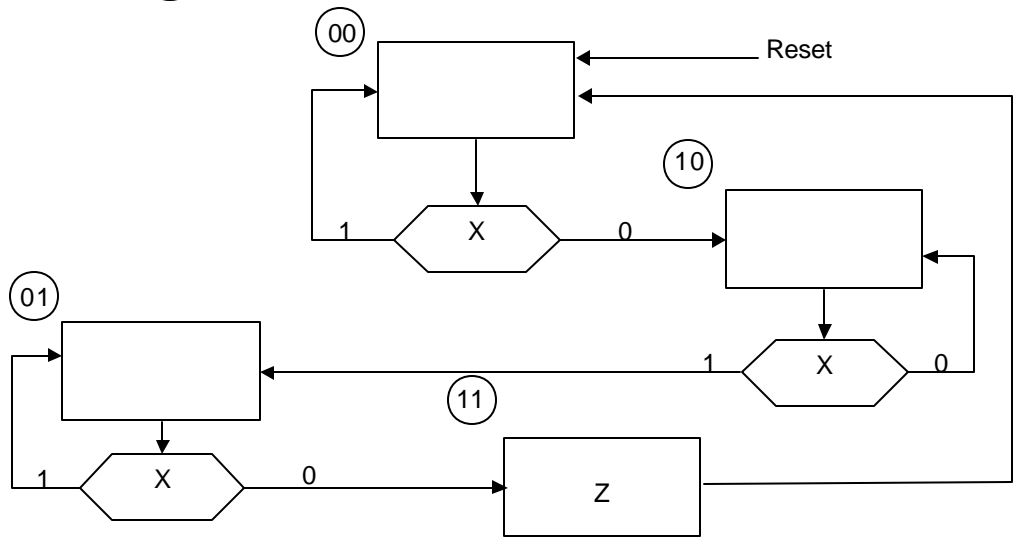
What is the propagation delay from the rising edge of one signal to the falling edge of the other?

- a) About 1 ns  
 b) About 6 ns  
 c) About 500 us  
 d) Impossible to say, since the two signals have different vertical scales  
 e) Impossible to say, since the two signals have different time bases

5. (5 pts) Which of the following might represent at least part of a Braitenberg-style approach to the final project? (Select all that apply.)
- a) decreasing one or both wheel velocities when a non-IR emitting object is detected anywhere along the front of the robot
  - b) estimating the location of an IR beacon and executing a series of planned moves to go to that location
  - c) accepting commands from a human operator using a TV remote control
  - d) increasing the left wheel velocity when the IR beacon is detected to the front right
  - e) using a constant “battery” to drive the robot constantly at some low speed, in addition to whatever effect sensors may have

6. (10 pts) For the following ASM diagram, fill in the transition table on the answer sheet. Use a lower-case “d” for “don’t cares,” if there are any.

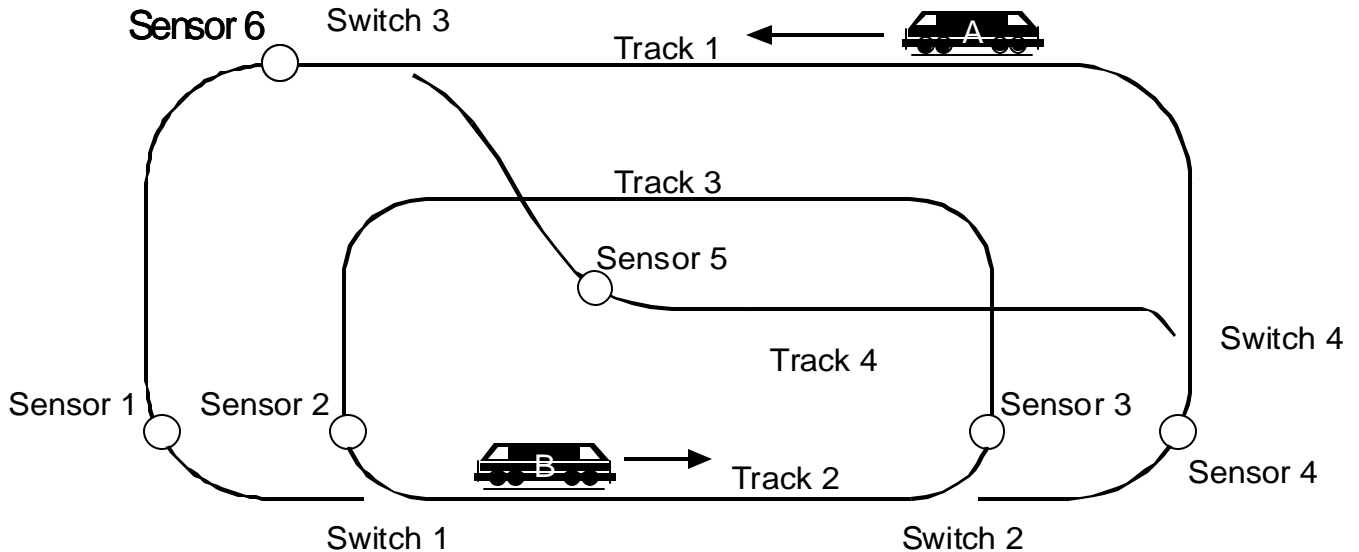
LEGEND:  $\textcircled{Q_1Q_0}$



Recall the starting point for the train problem given in lecture, shown below.

All you should need to know is

- for each sensor (S1-S6), 1 means a train is present (0 means not present),
- for each switch (SW1-SW4), 1 connects it to the inside track (0 connects outside track),
- for each track (T1-T4), 0 puts power supply A on the track, and 1 puts power supply B on the track
- the power supply direction bits DA1-DA0 (and DB1-DB0) are defined such that 00 is Stop, 01 is Forward (Counterclockwise) and 10 is Backward (Clockwise).



You are to make the trains move as follows:

- State “Bstop” – Train B stops, while Train A will continue moving CCW as shown in the starting position.
- State “Chase” – When Train A trips Sensor1 (S1), Train B begins moving CCW on the outside track, with Train A following behind.

Use Power Supply B exclusively for Track 1 (T1), and Power Supply A exclusively for Track 2 (T2). Use don't cares for T3 and T4 unless you see a need to do otherwise.

7. (5 points) It is possible to set all switches at settings that never change, but still solve this problem (i.e., they are not state-dependent). List the settings for SW1-4 on the answer sheet.
8. (10 points) Complete the ASM chart on the answer sheet to make the desired behavior occur.

9. (5 points) If this were run on the UP board, what will eventually happen to Train A and Train B?
- They will travel at a fixed separation distance
  - A will inevitably hit B from behind
  - B will inevitably hit A from behind
  - It depends on the DIP switch settings
  - None of the above
10. (5 points) Which of the following is NOT a characteristic of technical writing:
- Use of passive voice
  - Avoidance of personal pronouns
  - Use of declarative statements
  - Use of rhetorical questions
  - Use of problem-solution, general-to-specific organizational patterns
11. (5 points) Which of the following BEST describes the type of information found in an Abstract:
- Purpose, design specifications, procedures, results
  - Scope, purpose, procedures, results, conclusions
  - Scope, purpose, design specifications, conclusions
  - Procedures, results, conclusion
  - Scope, results, conclusions, acknowledgements
12. (5 points) The Conclusions section of a technical report is the place to analyze results and demonstrate critical thinking.
- TRUE
  - FALSE

On the answer sheet are short VHDL code segments that almost implement simple functions (all modified slightly from the textbook).

13. (5 pts) Match them to the following functions:
- Positive edge-triggered D flip-flop with synchronous reset
  - Positive edge-triggered D flip-flop with asynchronous reset
  - Counter
  - Moore state machine
  - Multiplexer
14. (20 pts) EVERY one of the VHDL models used for the previous example has an error. Correct each error on the answer sheet, crossing out as necessary and inserting text as necessary. Hint: None of the errors are errors of omission, so don't worry about missing LIBRARY statements, declarations, etc. You can assume that since these are only fragments of code, the all necessary headers and declarations preceded them.