

EEC 180A Midterm Exam

Fall 2004

November 3, 2003

This examination is closed book and closed notes, and no calculators are allowed. The only permitted help is a single page of notes.

For all problems, state any assumptions you make, show all work, and clearly mark your answers. Correct but unclear or ambiguous answers will not receive full credit.

Excerpts from the UC Davis Code of Academic Conduct state:

1. Each student should act with personal honesty at all times.
2. Each student should act with fairness to others in the class. This means, for example, that when taking an examination, students should not seek an unfair advantage over classmates through cheating or other dishonest behavior.
3. Students should take group as well as individual responsibility for honorable behavior. This includes notifying the instructor or TA if you observe cheating.

I understand the honor code and agree to be bound by it.

Signature _____

Name (printed) _____

Section number _____

Total points: 100

1) [9 points] Show all work.

- a) [3 points] Write -3_{10} in as an 8-bit 2's complement number
- b) [3 points] Write 45.25_{10} as a hexadecimal number
- c) [3 points] Show all steps to correctly add -3 and -6 using 2's complement binary numbers

2) [10 points] Define the following terms in a single sentence.

a) [2 points] *literal*

b) [2 points] *static 0 hazard*

c) [2 points] *dynamic hazard*

d) [2 points] *essential prime implicant*

e) [2 points] *don't care minterm*

3) [11 points] Simplify each of the following logic functions using a single theorem. State the theorem used.

a) [5 points] $f = Y'Z + (X + Y'Z)W + X$

b) [6 points] $f = (V'W + X)'(X + Y + Z + V'W)$

4) [10 points] Find the minimum sum-of-products solution for $f(a,b,c) = \sum m(1,3,5,7) + d(2,6)$, where $d(2,6)$ are the don't care minterms.

5) [20 points] You must design a circuit that detects special numbers on its 4-bit input. The output *odd*, goes to a high level when the input number is odd. The output *prime*, goes to a high level when the input number is a prime number (2, 3, 5, 7, 11, 13). The output *zeroeight*, goes to a high level when the input number is in the range 0-8. Label the four bits of the input number *a* (MSB), *b*, *c*, *d* (LSB).

a) [7 points] Minimum sum-of-products algebraic expression

b) [7 points] Minimum product-of-sums algebraic expression

c) [6 points] Minimum NOR-NOR circuit diagram

6) [20 points] Find the following for the function $f(a,b,c,d) = (a + c') (a' + b)$

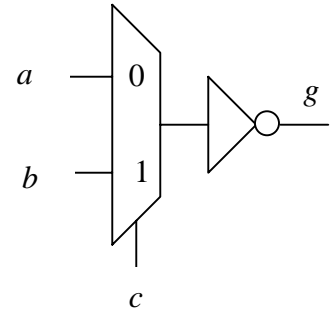
a) [8 points] Draw the circuit for the minimum NAND-NAND implementation of f

b) [4 points] State the number (zero or more) and type (0 or 1) of static hazards that may exist in this circuit

c) [4 points] If there are any static hazards, list all necessary input conditions for the hazard(s) to affect the output of the circuit. If there are none, explain why there are none.

d) [4 points] If there are any static hazards, list the minimum necessary group(s) needed to remove the hazard(s). If there are none, explain why no additional group(s) are needed.

7) [20 points] The function $g(a, b, c)$ is equivalent to a 2-input mux followed by an inverter as shown in the figure below.



a) [7 points] Write out the full truth table for g

b) [4 points] Find the minimum sum-of-products solution for g

c) [5 points] Draw the minimum circuit for g using only 3-input NAND gates

d) [4 points] If there are any static hazards, list their type (0 or 1) and the minimum necessary group(s) needed to remove the hazard(s). If there are none, explain why no additional group(s) are needed.

TA Instructions for ECE 180A midterm

Before exam

- Arrive early and reserve seat(s) in front row for people referred to Student Judicial Affairs (their names are circled on class rosters)
- Draw picture on board showing where students should sit according to section
- Let students know about the seating chart as they arrive (see if you notice any strange behavior by a “ringer” (someone not in the class trying to take the test))

When all students have arrived

- Remind them they need to be sitting in the correct section area
- Tell them to keep their exams **face down** on their desks until told to turn them over

[approx. 5:07pm] Hand out exams, checking off students in your lab section(s). Ask for ID if you do not recognize someone

Announcements to students before taking exam:

- Do not look at other people's exams
- Keep your answers covered
- You are not permitted to leave the room; if you do, you must turn in your exam [you can make an exception if someone looks like they desperately need to use the bathroom]
- Tell them: you are free to turn in exams and leave until 6:25pm, after then, you must stay until 6:30pm. At exactly 6:30pm, you must put your pencils down and pass your exam forward/left/right (as appropriate). If you delay even a few seconds, you will receive half credit, if you delay longer than a few seconds, you will receive a zero. These are instructions from Prof. Baas and will be enforced.

[5:12pm] Tell students to begin. If for some reason you begin late, this is ok; just adjust the ending time accordingly.

[6:15pm] Announcement: 15 minutes left

[6:25pm] Announcement: you are not permitted to leave until exams have been handed in; if you finish before then, stay seated and check your answers

[6:29pm] Announcement: 1 minute left

[6:30pm] Put down your pencils, pass your exam forward/left/right (as appropriate). Mark the exam of anyone who does not do this within a few seconds.

Other comments:

- Walk around during exam; look for cheat sheets; mark exams of cheaters with red pen
- Rule of thumb: keep exam going. If anything strange comes up, make a note or tell the student to make a note of it, and I'll deal with it later. It's important to give everyone a fair chance of finishing their exam.

cell phone numbers:

Bevan: 650-255-6476