Computer Science $03 - 60 - 265 - 01$
Second Midterm Examination
Tuesday, June 15^{th} 2004

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Last Name:

First Name:

Student Number:

INSTRUCTIONS

- EXAM DURATION IS 90 MINUTES.
- CALCULATORS, NOTES AND BOOKS ARE NOT ALLOWED.
- CHEATING IS NOT ALLOWED AND I WILL GIVE 0 FOR CHEATING.
- READ ALL QUESTIONS CAREFULLY BEFORE ANSWERING.
- WRITE YOUR FINAL ANSWERS IN THE FRONT OF PAGES. USE THE BACK OF PAGES FOR SCRAP WORKS.
- **WRITE YOUR FINAL ANSWERS WITH A PEN**.
- Attempt all questions.
- If you need to make any assumptions, state them clearly with your answers.
- Write your answer neatly. Messy work is very hard to read and may cause you to lose marks.
- Lists of Boolean properties and logic gates are given on pages 19 and 20.

Questions	Q#1	Q#2	Q#3	Total
Marks				
Totals	20	10	20	100

Question #1: (20 points) The following is the specification of a circuit that has four inputs called a, b, c, d, and four outputs called w, x, y, z. The inputs represent the *valid* BCD code of a decimal digit. The function of the circuit is to generate the Excess-3 code of the 9's complement of the input digit. The 9's complement $\bar{D}$ of a decimal digit D is defined as $\bar{D} = 9 - D$ (for instance, $\bar{3} = 6$, $\bar{7} = 2$, $\bar{0} = 9$, $\bar{5} = 4$, ...).

1. Fill in the truth table below that shows the four outputs

a	b	c	d	w	x	y	z
0	0	0	0				
0	0	0	1				
0	0	1	0				
0	0	1	1				
0	1	0	0				
0	1	0	1				
0	1	1	0				
0	1	1	1				
1	0	0	0				
1	0	0	1				
1	0	1	0				
1	0	1	1				
1	1	0	0				
1	1	0	1				
1	1	1	0				
1	1	1	1				

K-map for w

K-map for x

K-map for y

K-map for z

K-map for $\bar{w}$

K-map for $\bar{x}$

K-map for $\bar{y}$

K-map for $\bar{z}$

For each question on page 3, fill in the corresponding K-map above, accordingly.

2. Derive the minimal SOP expressions for w and x.

$w =$ _____...

$x =$ _____...

3. Derive the minimal POS expressions for y and z.

$y =$ _____...

$z =$ _____...

4. Derive the minimal POS expressions for
   - $\bar{w}$ by the *Direct Method*.

     $\bar{w} =$ _____...

   - $\bar{x}$ by the *Complement Method*.

     $\bar{x} =$ _____...

5. Derive the minimal SOP expressions for
   - $\bar{y}$ by the *Direct Method*.

     $\bar{y} =$ _____...

   - $\bar{z}$ by the *Complement Method*.

     $\bar{z} =$ _____...

Space for rough work for Question #1

Space for rough work for Question #1

Question #2: (10 points) The circuit shown below has the output f and the inputs x and y. You must show all of the steps for the questions below.

1. Derive the logic expressions for the intermediate nodes A, B, C and the output f (do not minimize f).

$A =$

$B =$

$C =$

$f =$

Question #3: (20 points) Design a Full Subtractor

Space for rough work for Question #3

Space for rough work for Question #3