CSC 258H1 Y 2016 Midterm Test
Duration — 1 hour and 50 minutes
Aids allowed: none

Student Number: ⌊ ⌋

UTORid: ⌊ ⌋

Last Name: _____ **First Name:** _____

Question 0. [1 MARK]

Read and follow all instructions on this page, and fill in all fields.

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*Do **not** turn this page until you have received the signal to start.*
(Please fill out the identification section above, **write your name on the back of the test**, and read the instructions below.)
Good Luck!

This midterm is double-sided, and consists of 9 questions on 14 pages (including this one). When you receive the signal to start, please make sure that you have all pages.

- If you use any space for rough work, indicate clearly what you want marked.
- Do not remove any pages from the exam booklet.
- Draw a smiley face in the bottom right corner of this page
- You may use a pencil; however, work written in pencil will not be considered for remarking.

0: _____/ 1
1: _____/ 5
2: _____/ 5
3: _____/ 9
4: _____/ 8
5: _____/12

TOTAL: _____/40

[Use the space below for rough work. This page will not be marked unless you clearly indicate the part of your work that you want us to mark.]

Question 1. [5 MARKS]

Answer the following questions in the space provided. When providing a written answer, please write **as clearly and legibly as possible**. Marks will not be awarded to unreadable answers.

(a) Convert the following numbers into binary. You need to use the smallest number of binary digits possible.

- Decimal number 35: _____
- Decimal number 217: _____

(b) Write the signed representations of the following decimal numbers (in 2's complement format). You need to use the smallest number of binary bits possible.

- Decimal number -13: _____
- Decimal number 23: _____

(c) What is the decimal value of the **signed** 8-bit binary number 10110101

(d) What is the decimal value of the **unsigned** 8-bit binary number 10110101

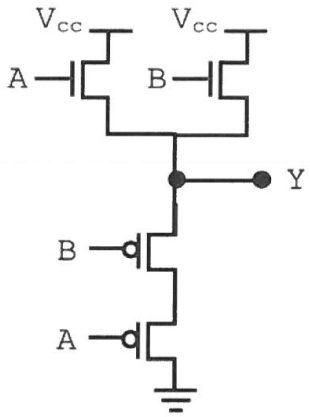
(e) Which of the following logical expressions are equivalent to $(A + B)'$? (circle all that apply).

- $(A' + B)B'$
- $(A' + B')'$
- $(A'B')$
- $(A + B')B'$
- $(A'B') + (A + A') + (B' + B)$
- $(A'B')(A + A')(B' + B)$

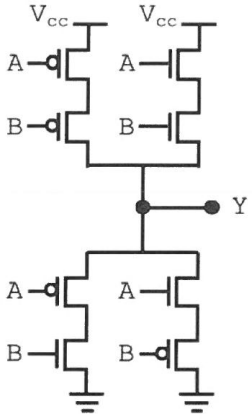
[Use the space below for rough work. This page will not be marked unless you clearly indicate the part of your work that you want us to mark.]

Question 2. [5 MARKS]

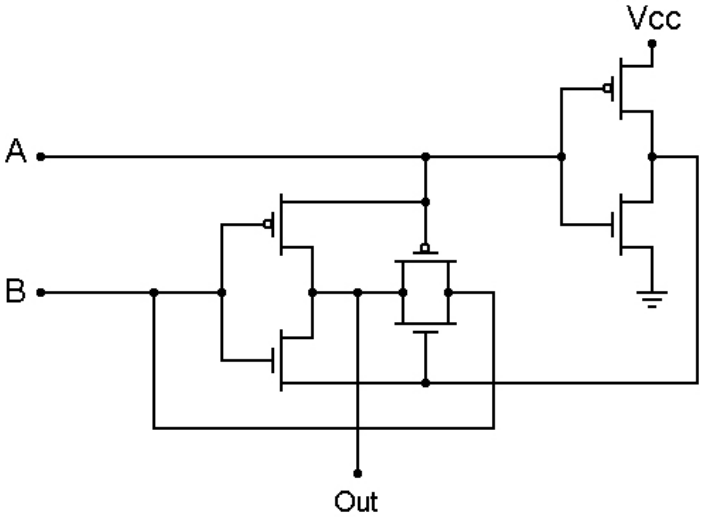
(f) Draw the truth tables of the following circuits in the space provided



A	B	Y
0	0	
0	1	
1	0	
1	1	



A	B	Y
0	0	
0	1	
1	0	
1	1	



A	B	Y
0	0	
0	1	
1	0	
1	1	

[Use the space below for rough work. This page will not be marked unless you clearly indicate the part of your work that you want us to mark.]

Question 3. [9 MARKS]

(a) Using only AND, OR, XOR and NOT gates, draw a half-adder.

(b) Using only AND, OR, XOR, NOT gates and your half adder from the previous question (even if you didn't get the previous question, we will assume a working half-adder for this one), draw a full adder.

(c) Using only AND, OR, XOR, NOT gates, and your half/full adder gates, draw a gate that takes a 4 bit input, and adds 5 (0101) to it.

[Use the space below for rough work. This page will not be marked unless you clearly indicate the part of your work that you want us to mark.]

Question 4. [8 MARKS]

Consider a circuit with 4 inputs, and 1 output that should go high whenever 2 or more of the inputs are high (and be low otherwise)

(a) Draw the Karnaugh map for this circuit

(b) Show the groupings and provide a reduced sum of minterms expression for the circuit

(c) Provide a reduced product of maxterms for the same circuit

[Use the space below for rough work. This page will not be marked unless you clearly indicate the part of your work that you want us to mark.]

Question 5. [12 MARKS]

We need to build a traffic light that cycles $green \rightarrow yellow \rightarrow red$ whenever the `change` input is high, and stays in the same position whenever `change` is low.

(a) Draw the FSM for the traffic light

(b) Draw the state table for the traffic light

(c) Produce a series of boolean expressions for the traffic light

[Use the space below for rough work. This page will not be marked unless you clearly indicate the part of your work that you want us to mark.]

(d) Draw the circuit diagram for the traffic light. Assume we want a change signal to occur approximately (give or take 1 cycle) every 8 clock cycles, and you have outputs `green` `yellow` `red` that make the lights go on respectively. You may use any circuits we've covered in lecture. If you can't remember the block diagram for a circuit, just clearly indicate what type of gate/circuit you intend.

Last Name: _____ **First Name:** _____