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BLG231E Digital Circuits
Homework 1

Deadline: 21/10/2016 (before 9:30)

1. CONVERSION BETWEEN NUMBER REPRESENTATIONS

Perform the following number conversions:

- **a)** Binary $(100111.10111)_2$ to decimal, octal and hexadecimal.
- **b)** Octal $(72.6)_8$ to decimal, binary and hexadecimal.
- **c)** Hexadecimal $(C3.AD5)_{16}$ to decimal, binary and octal.
- **d)** Binary $(11011100101010101010100010111111101000111111)_2$ to hexadecimal

2. SIMPLIFIED SUM OF PRODUCT (SOP) EXPRESSIONS

Express the following Boolean functions in SOP forms with using minimum number literals. Write down the total **number of literals** for your simplified expressions (for example, $x_1\overline{x_2}x_3 + x_1\overline{x_3}$ has 5 literals).

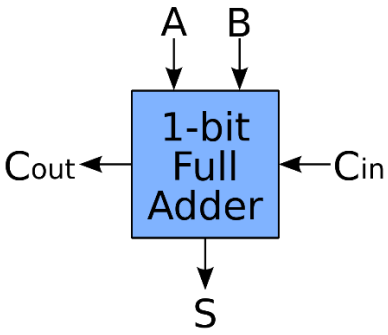
- **a)** $f_1 = \overline{x_1x_2 + x_2x_3 + x_3x_4}$
- **b)** $f_2 = \overline{\overline{x_1}x_2x_3 + x_1x_4}$
- **c)** $f_3 = \overline{x_1\overline{x_2}x_3 + x_1\overline{x_4} + x_2x_3\overline{x_4}}$
- **d)** $f_4 = \overline{x_1x_2\overline{x_3} + x_1\overline{x_2}x_3 + \overline{x_1}x_2x_3 + \overline{x_1}\,\overline{x_2}\,\overline{x_3}}$

3. DESIGNING A 4-INPUT & 1-OUTPUT CIRCUIT

Consider a circuit with 4 inputs and 1 output such that a transition (0-to-1 or 1-to-0) in one of the inputs always results in a transition at the output (0-to-1 or 1-to-0). Derive the **truth table** of this circuit.

4. DESIGNING A 1-BIT FULL ADDER

Consider a 1-bit full adder with its circuit symbol and truth table shown below.



Inputs			Outputs	
A	B	Cin	Cout	S
0	0	0	0	0
0	0	1	0	1
0	1	0	0	1
0	1	1	1	0
1	0	0	0	1
1	0	1	1	0
1	1	0	1	0
1	1	1	1	1

- **a)** Derive Boolean functions of the outputs in terms of the inputs in both SOP and POS forms. There should be total of 4 expressions.
- **b)** Implement the adder by only using NAND-2 gates. In your implementation, you need to use the expressions derived in **a)**. Minimize the number of NAND-2 gates in your design.
- **c)** Implement the adder by only using NOR-2 gates. In your implementation, you need to use the expressions derived in **a)**. Minimize the number of NOR-2 gates in your design.

Grading: 1a)3%, 1b)3%, 1c)3%, 1d)3%
2a)7%, 2b)7%, 2c)7%, 2d)7%
3)15%
4a)15%, 4b)15%, 4c)15%

Note: *Return a hard-copy of your homework.*