

Fall 2016

BSM 203 Logic Circuits

Homework #1

Instructions:

- The due date for this homework is **October, 31 at 5:00 pm.**
- You can hand in your homework before the class starts, drop it to room 1153, or send it via e-mail (saubsm203@gmail.com) with a subject line "BSM 445 – Homework 1 - <student name> - <student number>" with condition of handing in the hardcopies later.
 - Only the e-mail with proper subject line will be accepted
 - Student is responsible to check the attachment to emails. Instructor may not notice no-attachment e-mails and therefore cannot be hold responsible for warning student in time.
 - You can send photos of a handwritten homework, but have to hand in the hardcopies. Without hardcopies, homeworks will not be evaluated from photos. This is also valid for other types of e-mailed homeworks. Please write the following statement on to your late handed-in homework: "A softcopy of this homework is submitted before the deadline."
- Note that there are 4 questions in this homework.
- Homework will not be accepted after due date unless instructor suggested otherwise.
- All students are expected to work individually. Discussions among students are encouraged, but homework must be prepared, written, and submitted individually.
- Do not waste your time by googling the homework questions. Solving may take much shorter time.
- If the hardcopy homeworks has more than one paper sheet, then you should staple the sheets close to upper left corner such that no writings is blocked.

Honor code:

As student(s) who has/have signature(s) below, I/We pledge that I/we follow the rules of honor code below and directions above while doing the homework.

- 1-) Students can only share information (especially answers) within the group (if it is a group homework), but not with other students in class or in other programs. However methods can be discussed.
- 3-) Sharing questions or answers outside of institution, on social media, on homework websites, or any other similar medium is strictly forbidden.
- 4-) If honor code and directions are not followed, the instructor has right to pursue any legal actions specified in university regulations.
- 5-) Homeworks without signatures will not be accepted.

Student Number

Name and Surname

Signature

Date

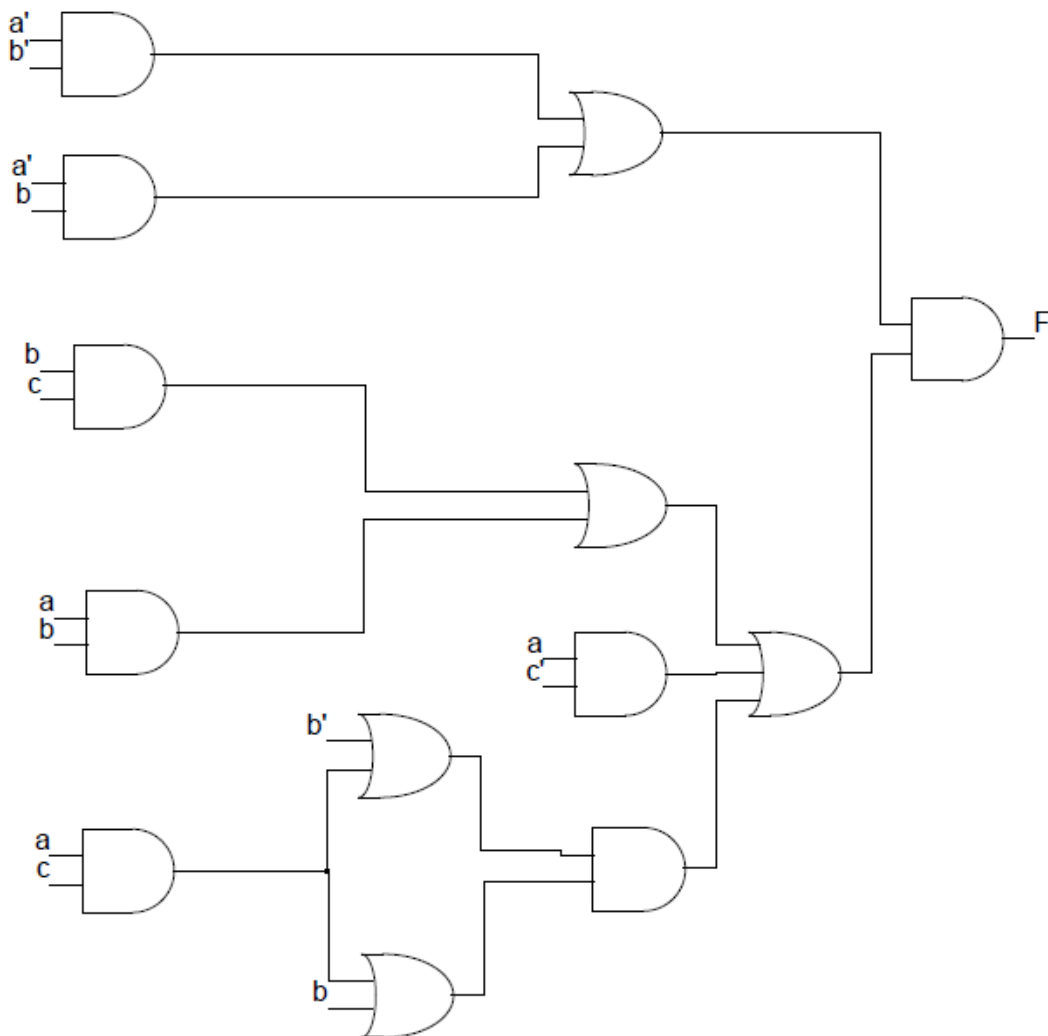
Questions:

1) [15 points] [Introduction to Number Systems and Conversion]

- a) Add the first three digits of your student number to last 3 digits. Let A denote the result. For example, if your number is 121210102, then $A = 121 + 102 = 223$. Then convert A to
 - i. Binary
 - ii. Octal
 - iii. Hexadecimal
- b) Let B be the last non-zero digit of your number. Do following operations in binary system
 - i. $A + B$
 - ii. $A - B$
 - iii. $A \times B$
- c) Calculate $A - B$ without subtraction, but with addition of A to $-B$ by using 2's complement.
- d) Take the last five digits of your number. After the 3rd digit put a decimal point. Let C denote the result. For example, if your number is 121210102, then $C = 101.02$. Convert C to binary.
- e) Show C in 8-4-2-1 code, 6-3-1-1 code, and Gray code.

2) [25 points] [Boolean Algebra] Simply expression F for each question below. (F is a different function for each question.)

a) F is shown as logic circuit diagram.



b) F is given as truth table. (Since the table is too long, we show it in two parts. Right table is continuation of the left table.)

t	w	x	y	z	F	t	w	x	y	z	F
0	0	0	0	0	1	1	0	0	0	0	1
0	0	0	0	1	1	1	0	0	0	1	1
0	0	0	1	0	0	1	0	0	1	0	0
0	0	0	1	1	0	1	0	0	1	1	0
0	0	1	0	0	0	1	0	1	0	0	1
0	0	1	0	1	0	1	0	1	0	1	1
0	0	1	1	0	1	1	0	1	1	0	1
0	0	1	1	1	1	1	0	1	1	1	1
0	1	0	0	0	0	1	1	0	0	0	0
0	1	0	0	1	0	1	1	0	0	1	0
0	1	0	1	0	1	1	1	0	1	0	0
0	1	0	1	1	1	1	1	0	1	1	1
0	1	1	0	0	1	1	1	1	0	0	1
0	1	1	0	1	1	1	1	1	0	1	0
0	1	1	1	0	0	1	1	1	1	0	0
0	1	1	1	1	0	1	1	1	1	1	0

3) [35 points] [Boolean Algebra]

- a) $F = k'm'p + nr + kpr + n'p + mpr$
 - i) Simplify it to sum-of-product form with minimum number of products.
 - ii) Simplify it to product-of-sum form with minimum number of sums.
- b) $G = AC + BDE + AB' + BC'D' + BEF$
 - i) Simplify it to sum-of-product form with minimum number of products.
 - ii) Simplify it to product-of-sum form with minimum number of sums.
- c) $H = (x' + w' + y')(x' + y + z')[y'z'(w' + x) + wy(x' + z)]'$
 - i) Simplify the expression without taken the dual form of it.
 - ii) Now find the dual form of it (H_D) and simplify H_D and take the dual of H_D again to find the simplified version of H .
- d) Simplify the following expression: $[(D' + E')(E + F)][(F' + G')(D' + G')]$

4) [25 points] [Minterm and Maxterm Expansions] An automatic sprinkler system, which consists of temperature sensor, humidity sensor, a wifi module to receive weather forecast, and a time clock, goes on ($F = 1$) when

- When a rain is not forecasted and,
- The temperature is over 20°C and time is before 6 pm or,
- The humidity of the soil is low, temperature is below 20°C and time is before 6 pm.

Based on these rules;

- a) construct the truth table for F with proper inputs.
- b) find the simplest expression for F .
- c) express F and F' as a minterm expansion.
- d) express F and F' as a maxterm expansion.