MID-TERM EXAM SIMULATION (Nov. 26th, 2020)

Exercise 1 (4 points): By using the Boolean algebra, prove the following equality:

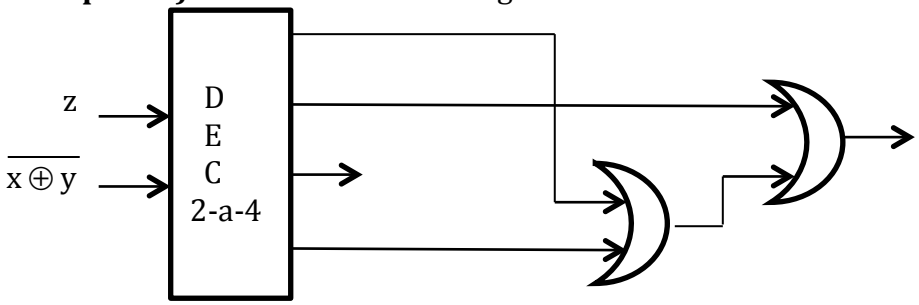
$$x + (x + \overline{z})(\overline{x} + y) + y = x + \overline{z} + y$$

Then, write the dual and the complementar of such equality.

Exercise 2 (3 points): Write the truth table of the control circuit of an alarm system. The alarm is activated when the correct PIN number is given or when a signal from the remote controller is received; moreover, no door nor window must be open. Finally, assume that the alarm is never simultaneously activated with the PIN number and the remote controller.

Exercise 3 (4 points): Sum and multiply the following two numbers in the IEEE half-precision format: <0;10011;1001110000> and <1;10110;1001000000>. The obtained results are exact or approximate?

Exercise 4 (3+1+2 points): Consider the following circuit:



a) give the boolean expression associated to the exit of the circuit;
b) give the associated truth table;
c) find the minimum boolean expression for the resulting boolean function.

Exercise 5 (2+3+2 points): Given the following truth table:

X Y Z	***A B C***
0 0 0	1 0 1
0 0 1	1 0 0
0 1 0	1 1 1
0 1 1	1 0 1
1 0 0	0 1 1
1 0 1	1 1 0
1 1 0	0 1 0
1 1 1	1 0 0

a) implement C with a MUX 2-to-1;
b) implement the boolean function described by the truth table with a PLA;
c) find an ALL-NAND expression for A.

Exercise 6 (4 points): Convert 284_{10} in base 4. The turn the obtained number in base 16 and sum such a number to $2A4_{16}$. Finally, turn the result in base 2 and write its opposite (working in the format of 2-complement with 12 bits).

Exercise 7 (2 points): Say whether 1111001 is a Hamming 4-to-3 codeword and, if not, identify where the error took place.