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Name Surname:

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18 Nov. 2011

DIGITAL CIRCUITS 1st MIDTERM EXAM (Question 1)

Regulations:
1. Duration is 100 minutes.
2. Asking questions to proctors is not allowed.
3. Any cheating or any attempt to cheat will be subject to the University disciplinary proceedings. Cell phones are prohibited on the desk, they must be switched off.

QUESTION 1 (30 Points):

a. A and B are two 8-bit, **signed**, binary integers. B is given as B=1001 1101. If we perform the operation A-B according to **2's complement** method overflow occurs and the most significant bit of the 8-bit result is 1.
i) What is the sign of A (positive or negative)? Why?
ii) Write the smallest possible integer A that can constitute this situation (result and overflow).

b. A and B are two 8-bit, **unsigned**, binary integers. After the operation A-B according to **2's complement** method the obtained result is a 9-bit number: 1 1001 0110.
Which is true A>B or A<B? Why?

Solution:

Number:
Name Surname:

DIGITAL CIRCUITS 1st MIDTERM EXAM (Question 2)

QUESTION 2 (30 Points):

a. E and F are two expressions, which do not include the literal a. Write the expression in PoS form, of which E+F is the consensus term respect to a.
Note: To show complements put a dash over literals, such as $\bar{a}$.

b. Write the consensus theorem for the obtained expression in PoS form (above) and prove it (in PoS form) using the axioms and theorems of the Boolean algebra.

c. Minimize the given expression using the consensus theorem and other necessary theorems of the Boolean algebra. z = ab'c + ab + acd + a'b
To show complements put a dash over literals, such as $\bar{a}$.
Implement the minimized expression using **only** 2-input NAND gates.

Number:
Name Surname:

DIGITAL CIRCUITS 1st MIDTERM EXAM (Question 3)

QUESTION 3 (40 Points):
Expression of a function f(a,b,c,d) is given in 2nd canonical form that includes 6 maxterms.
f(a,b,c,d)= (a+b+c+d′)(a+b′+c+d′)(a′+b′+c+d)(a′+b′+c+d′)(a′+b′+c′+d)(a′+b+c+d′)

a. Draw the Karnaugh map of the function f(a,b,c,d) and find all prime implicants.
b. Find all prime implicants of the **complement** ($\bar{f}$(a,b,c,d)) of the function using the Quine-McCluskey method.