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DIGITAL CIRCUITS 1st MIDTERM EXAM SOLUTIONS

SOLUTION 1 (30 Points):

a. B is negative, result is negative, there is an overflow, and operation is subtraction
i) Overflow condition: pos – neg = neg , therefore A must be **positive**. [10 points]
ii) A = 0xxx xxxx   0xxx xxxx
B= 1001 1101   2's comp. + 0110 0011   smallest possible A= 0001 1101
R= 1xxx xxxx   1xxx xxxx
[10 points]

The same solution by thinking in decimal:
B= $(-99)_{10}$, to generate an overflow result must be at least +128. (Note that result seems to be negative, but due to overflow the real sign of the result is positive.)
A-99=128, smallest possible **A=$(29)_{10}$ = 0001 1101**

b. The carry bit is 1. It means **no borrow**. Therefore A>B.   [10 points]

SOLUTION 2 (30 Points):

a) [5 pts]

Expression:
(a+E)(a'+F) or (a'+E)(a+F)

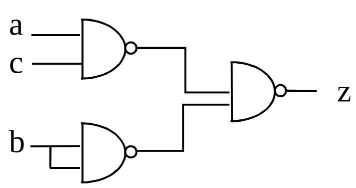
b) [10 pts]

(a+E)(a'+F)(E+F)	= (a+E)(a'+F)(E+F+aa')	Inverse and identity
	= (a+E)(a'+F)(E+F+a)(E+F+a')	Distribution
	= (a+E)(1+F)(a'+F)(1+E)	Identity
	= (a+E)(a'+F)	

c) [10 pts]

z	= ab'c+acd+ab+a'b	
	= ab'c+acd+b(a'+a)	Distribution
	= acd+ab'c+b	Inverse
	= acd+ab'c+b+ac	Consensus
	= ac(d+b'+1)+b	Distribution and identity
	= ac+b	

[5 pts]



SOLUTION 3 (40 Points):

a. Maxterms (0 generating inputs): 0001, 0101, 1100, 1101, 1110, 1001

ab \ cd	00	01	11	10
00	1		1	1
01	1		1	1
11			1	
10	1		1	1

[5 points]

Prime Implicants:
b'd' , a'd', a'c, b'c, cd

[15 points]

b. [20 points]

False (0) points of function f are true (1) points of the **complement** ($\bar{f}$(a,b,c,d)).

Num	abcd
1	0001√
5	0101√
9	1001√
12	1100√
13	1101√
14	1110√

Num	abcd
1,5	0-01√
1,9	-001√
5,13	-101√
9,13	1-01√
12,13	110- **X**
12,14	11-0 **X**

Num	abcd
1,5,9,13	- - 01 **X**

Prime Implicants:
abc' , abd', c'd