

## Universidad Carlos III de Madrid Digital Electronics. 1<sup>st</sup> partial exam. March, 2012 Groups 65,69,79,95.

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Time: 1h. 15'

Hand in the solutions of questions 1 and 3 together, in this sheet of paper.

Hand in question 2 separately, in a different set of sheets.

#### **Question 1 (3 pts)**

Obtain the representation of +1Fh and -2Ah in decimal, binary and octal systems and encode them using 2s-complement code. Encode +1Fh in BCD and Gray's codes.

Hexadecimal	+1Fh	-2Ah		
Decimal system	+31	-42		
Binary system	+11111	-101010		
Octal system	+37	-52		
BCD	110001			
Gray's code	10000			
2s-complement	011111	1010110		

#### Question 2 (4 pts)

Given the following boolean function:

$$f(a,b,c,d) = \prod_{A} (0,2,7,8,9,15) + \Delta(1,4,10)$$

- a) Find a simplified expression for f as a product of sums.
- b) Find a simplified expression for f as a sum of products.
- c) Find an expression using only NAND operations (it is not required to show the graphical representation of the circuit).
- d) Implement f with a decoder with active-low outputs. Point out first which is the most suitable size for the decoder.
- e) Implement f with a MUX2 (multiplexer with 4 data inputs) and additional logic if needed (only one MUX2).

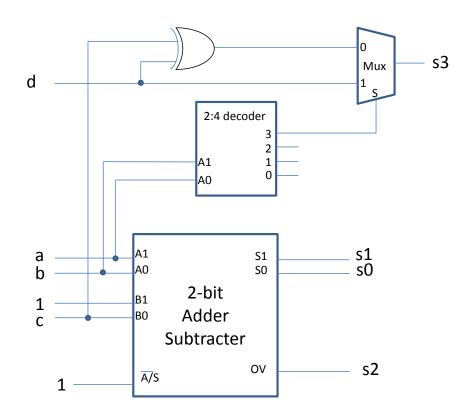
**Important note**: In the correction it will be considered if the solutions have the minimum possible number of components.



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### Question 3 (3 pts)

Fill out the truth table for the following circuit with inputs a,b, c, d and outputs s0, s1, s2 and s3:



								Hint:			
a	b	c	d	s3	<b>s2</b>	s1	<b>s0</b>	A	В	A-B	S
0	0	0	0	0	1	1	0	0	-2	2	0
0	0	0	1	1	1	1	0	0	-2	2	0
0	0	1	0	1	0	0	1	0	-1	1	0
0	0	1	1	0	0	0	1	0	-1	1	0
0	1	0	0	0	1	1	1	1	-2	3	0
0	1	0	1	1	1	1	1	1	-2	3	0
0	1	1	0	1	1	1	0	1	-1	2	0
0	1	1	1	0	1	1	0	1	-1	2	0
1	0	0	0	0	0	0	0	-2	-2	0	0
1	0	0	1	1	0	0	0	-2	-2	0	0
1	0	1	0	1	0	1	1	-2	-1	-1	0
1	0	1	1	0	0	1	1	-2	-1	-1	0
1	1	0	0	0	0	0	1	-1	-2	1	1
1	1	0	1	1	0	0	1	-1	-2	1	1
1	1	1	0	0	0	0	0	-1	-1	0	1
1	1	1	1	1	0	0	0	-1	-1	0	1