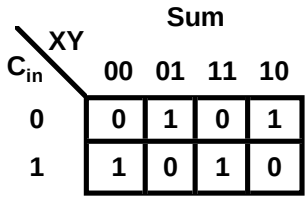
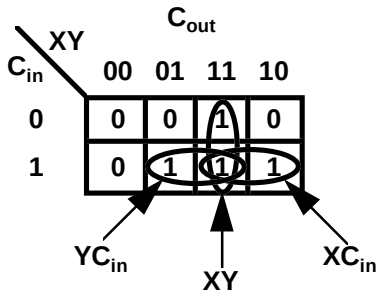
CS240 Midterm **March 13, 2003** **Answers**

1 (a.) Show the truth tables for the Sum (S) and Carry-out (C_{out}) of a Full adder in terms of the two input bits (X, and Y), and the Carry-in (C_{in}). (10 pts.)
(b.) Draw the Karnaugh Maps for the S and C_{out} and derive minimal sums of products. (10 pts.)
(c.) Show the NAND gate implementations of S and Cout. You may assume that X#, Y#, and C_{in}# are also present and need not show inverters to generate them. (10 pts.)
(d.) Implement S using a 4 input MUX. (10 pts.)

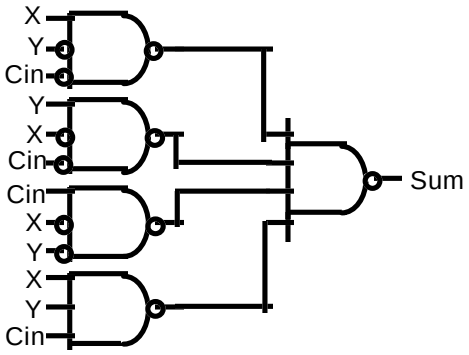
X	Y	Cin	S	Cout
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

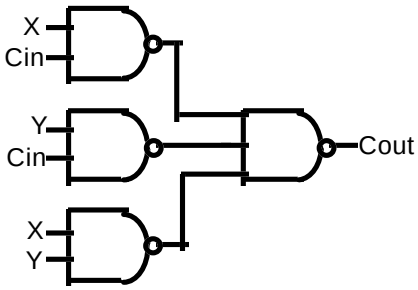


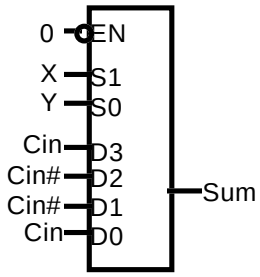


Sum = X#Y#C_{in} + X#YC_{in}# + XY#C_{in}# + XYC_{in}

C_{out} = XC_{in} + YC_{in} + XY







2 A and B are two signed integers in 2's complement format. A is 7F9 (hexadecimal) and B is CAB (Hexadecimal).
(a.) Convert B to Octal. (5 pts.)
(b.) Add A and B and show the result in Hexadecimal. (5 pts.)
(c.) Convert B to decimal. (5 pts.)
(d.) Convert the decimal number 1234 to the ternary -- base 3 -- number system. (5 pts.)

(a.) CAB Hex. = 1100 1010 1011 = 110 010 101 011 = 6253 Octal

(b.)
110010101011
011111111001
010010100100 = 4A4 Hex.

(c.) CAB is a negative number because the most significant bit (msb) is a 1. to find its value we must first take the 2's complement = 0011 0101 0101 = 355 Hex. $3*16^2 + 5*16^1 + 5*16^0 = 853$. The decimal value of CAB therefore equals -853.

(d.) 1234/3 = 411 with a remainder of 1
411/3 = 137 with a remainder of 0
137/3 = 45 with a remainder of 2
45/3 = 15 with a remainder of 0
15/2 = 5 with a remainder of 0
5/3 = 1 with a remainder of 2
1/3 = 0 with a remainder of 1
The ternary value is therefore 1200201

3 Figure 1 below shows a circuit and its input waveforms A and B. ON THE DIAGRAM, show the output waveforms, C and D. The diagram also shows a unit gate delay. Your answers must include the appropriate gate delays from the events that cause the transitions. (40 pts.)

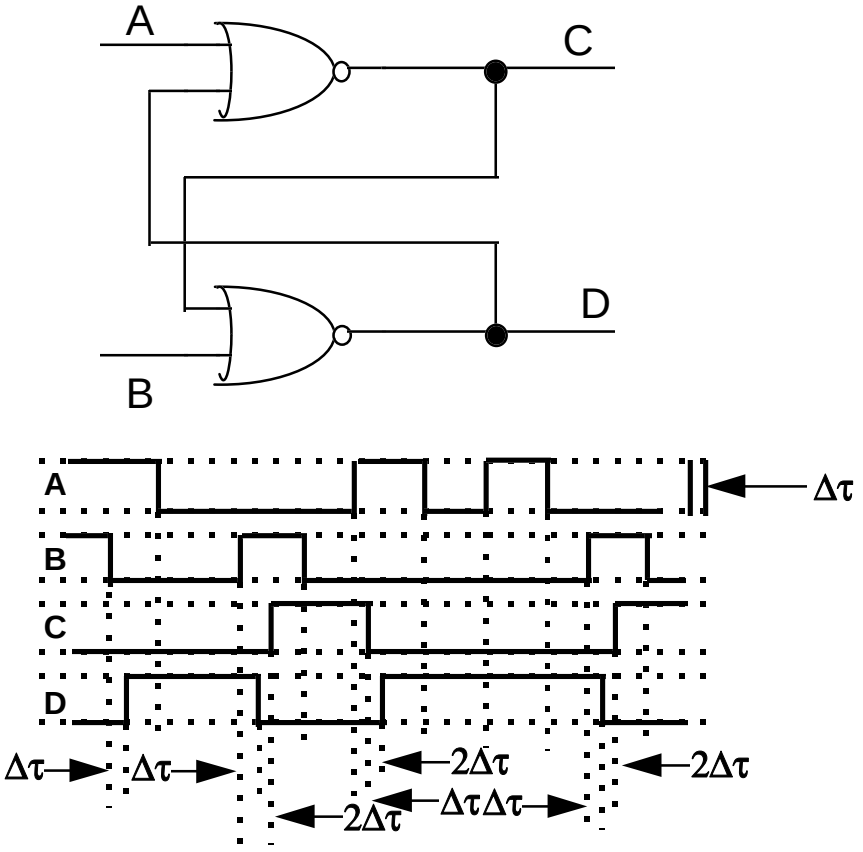


Figure 1