CS240 **October 21, 2004** **Midterm** **Answers**

Note: It is departmental policy to give a failing grade in the course to any student who gives or receives aid on any examination or quiz.

1. Figure 1 shows a circuit and the input waveforms. **On the diagram**, draw the waveforms of the outputs F, G1, G2, G3. Show the number of gate propagation delays relative to the feature that causes the change. (G1, G2, G3 = 5 pts, F = 15 pts.)

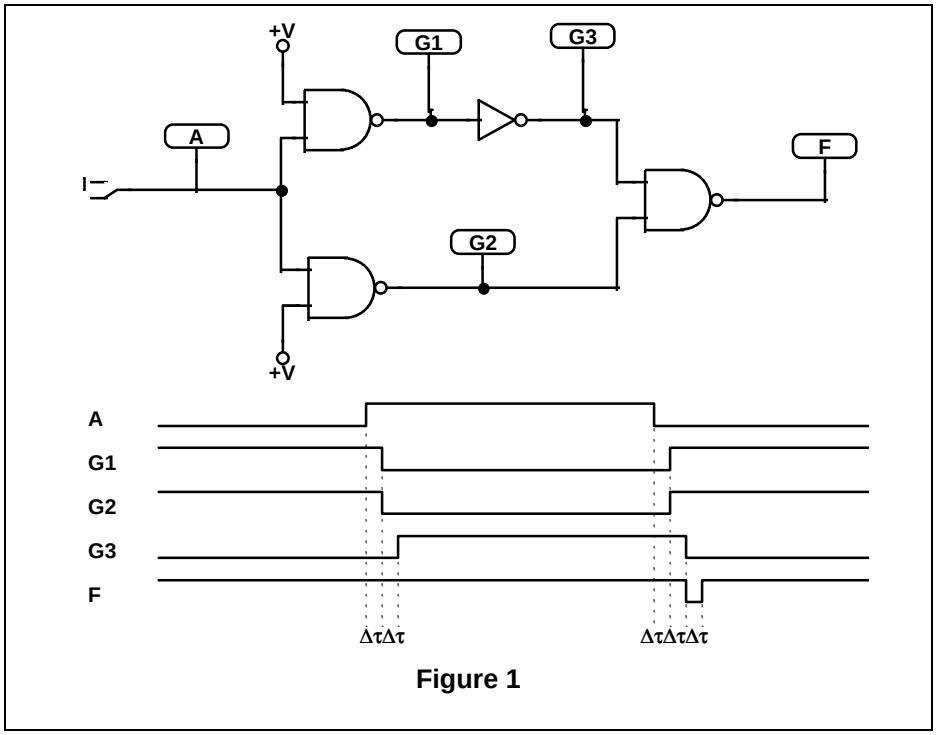
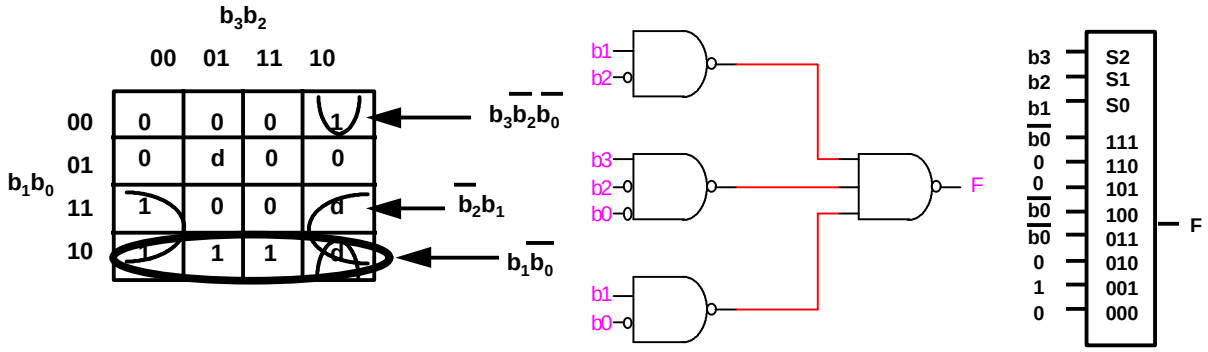


Figure 1

2. Shown below is the truth table for a function of four variables, b_3, b_2, b_1, and b_0. The truth table has been split in half to save space, but it represents a single table

Hex	b_3	b_2	b_1	b_0	F		Hex	b_3	b_2	b_1	b_0	F	
0	0	0	0	0	0	0	8	1	0	0	0	1	$\overline{b_0}$
1	0	0	0	1	0		9	1	0	0	1	0	
2	0	0	1	0	1	1	A	1	0	1	0	d	0
3	0	0	1	1	1		B	1	0	1	1	d	
4	0	1	0	0	0	0	C	1	1	0	0	0	0
5	0	1	0	1	d		D	1	1	0	1	0	
6	0	1	1	0	1	$\overline{b_0}$	E	1	1	1	0	1	$\overline{b_0}$
7	0	1	1	1	0		F	1	1	1	1	0	

(a) Use a Karnaugh map to derive the minimal sum of products. (10 pts.)
(b) Implement the function using only NAND gates (any number of inputs). In answering this question and in part c that follows, you may assume that the inverted forms of the input variables are available and you need not show inverters. (10 pts.)
(c) Use a 8 input multiplexer to form a circuit to implement the function. (10 pts.)
(d) Give the canonical product of sums for the function. (10 pts.)



(c) $F = (b_3+b_2+b_1+b_0)(b_3+b_2+b_1+b_0\#)(b_3+b_2\#+b_1+b_0)(b_3+b_2\#+b_1\#+b_0\#)(b_3\#+b_2+b_1+b_0\#) \bullet$
$\bullet(b_3\#+b_2\#+b_1+b_0)(b_3\#+b_2\#+b_1+b_0\#)(b_3\#+b_2\#+b_1\#+b_0\#)$

$F = \Pi\ (0, 1, 4, 7, 9, 12, 13, 15)$

3. A and B are two signed integers in 2's complement format. A is 7FC (hexadecimal) and B is F2B (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 7986 to the base 11 number system. The "digits" in base 11 are 0 … A. (5 pts.)
(e.) Show the IEEE 754 single precision Floating-Point representation of the decimal number -335.8984375. (10 Pts.)

(a.) F2B = 1111 0010 1011 = 111 100 101 011 = 7453 Octal.

(b.)
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011111111100
111100101011
011100100111
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= 727 Hexadecimal.

(c.) F2B is a negative number because the first bit is a 1 therefore use the 2's complement = 000011010101 = 0D5 Hex = 0 x 256 + 13 x 16 + 5 '= 213 decimal. The result is therefore -213.

(d.) 7986/11 = 726 R = 0
726/11 = 66 R = 0
66/11 = 6 R = 0
6/11 = 0 R = 6
7986 = 6000 Base 11

(e.) 335 = 101001111 Binary

0.8984375	x 2 =	1.796875
0.796875	x 2 =	1.59375
0.59375	x 2 =	1.1875
0.1875	x 2 =	0.375
0.375	x 2 =	0.75
0.75	x 2 =	1.5
0.5	x 2 =	1.0

335.8984375 = 101001111.1110011 = $1.010011111110011 \times 2^8$ the exponent excess 127 = 135 = 10000111
The number is negative so the most significant bit is a 1. Therefore =
1 10000111 010011111110011
= C3A7F300