CS240 **March 18, 2004** **Midterm** **Answers**

1. Figure 1 shows a circuit and the input waveforms. **On the diagram**, draw the waveforms of the outputs C and D. Show the number of gate propagation delays relative to the nearest dashed vertical line. (30 pts)

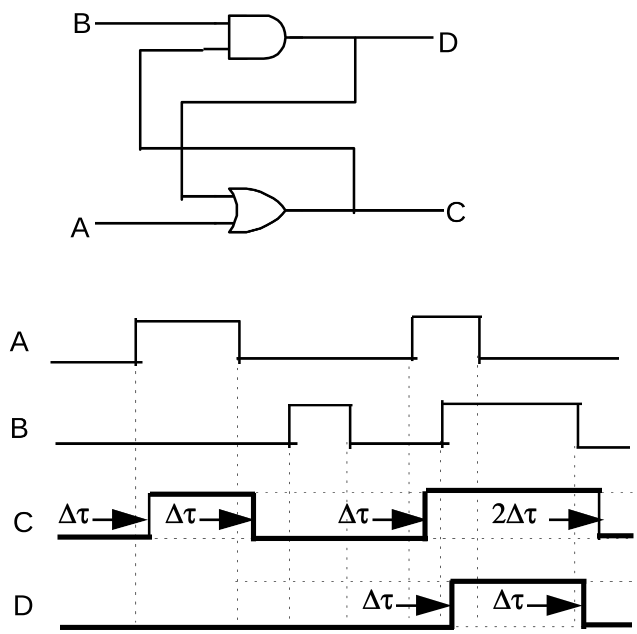


Figure 1

2. Figure 2 shows a 7 segment **DECIMAL** display.

(a) Draw the truth table for segment “e” as a function of the 4 bits, $b_3b_2b_1b_0$, to represent the **Decimal** digits 0 - 9 and show the canonical sum of products equation. (10 Pts.)

(b) Use a Karnaugh map to derive the minimal sum of products. (10 Pts.)

(c) Implement the minimized function using **only** NAND gates (any number of inputs). In answering this question and in part d below you may assume that the inverted forms of the input variables are available and need not show the inverters. (10 Pts.)

(d) Use an 8 input multiplexer to form a circuit to implement segment “e”. (10 Pts.)

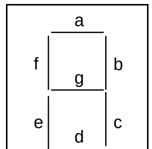
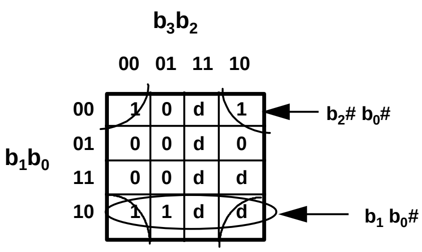
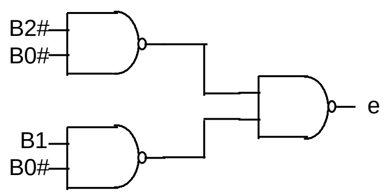


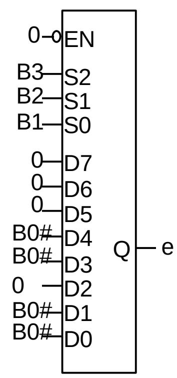
Figure 2

b_3	b_2	b_1	b_0	e	b_3	b_2	b_1	b_0	e	b_3	b_2	b_1	b_0	e	b_3	b_2	b_1	b_0	e
0	0	0	0	1	0	1	0	0	0	1	0	0	0	1	1	1	0	0	d
0	0	0	1	0	0	1	0	1	0	1	0	0	1	0	1	1	0	1	d
0	0	1	0	1	0	1	1	0	1	1	0	1	0	d	1	1	1	0	d
0	0	1	1	0	0	1	1	1	0	1	0	1	1	d	1	1	1	1	d

$e = b_3\# \, b_2\# \, b_1\# \, b_0\# + b_3\# \, b_2\# \, b_1 \, b_0\# + b_3\# \, b_2 \, b_1 \, b_0\# + b_3 \, b_2\# \, b_1\# \, b_0\#$







3 A and B are two signed integers in 2's complement format. A is FFE (hexadecimal) and B is BAC (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 base 5 number system. (5 pts.)
(e.) Show the IEEE 754 single precision Floating-Point representation of the decimal number -231.65625 (10 Pts.)

(a.) BAC = 1011 1010 1100 = 101 110 101 100 = 5654 Octal

(b.)

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  101110101100
  111111111110
  ------------
  101110101010  = BAA
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(c.) BAC is a negative number because the first bit is a 1 therefore use the 2's complement = 010001010100 = 454 Hex = 4 x 256 + 5 x 16 + 4 '= 1108 decimal. The result is therefore -1108.

(d.) 1234/5 = 246 R = 4
246/5 = 49 R = 1
49/5 = 9 R = 4
9/5 = 1 R = 4
1/5 = 0 R = 1
1234 = 14414 Base 5

(e.) 231 = 11100111 Binary

0.65625 x 2 = 1.3125
0.3125 x 2 = 0.625
0.625 x 2 = 1.25
0.25 x 2 = 0,5
0.5 x 2 = 1.0

231.65625 = 11100111.10101 = 1.110011110101 x 2^7 the exponent excess 127 = 134 = 10000110
The number is negative so the most significant bit is a 1. Therefore = 1 10000110 110011110101
= C367A800