

Université d'Ottawa
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uOttawa

L'Université canadienne
Canada's university

University of Ottawa
Faculty of Engineering

School of Electrical Engineering
and Computer Science

ITI 1100: Digital Systems 1

SAMPLE MIDTERM EXAM SOLUTIONS

First Name: _____

Last Name: _____

Student Number: _____

Question 1

- a. What is the largest binary number that can be expressed with 16 bits? What are the equivalent decimal and hexadecimal numbers?

16-bit binary: 1111_1111_1111_1111

Decimal equivalent: $2^{16} - 1 = (65535)_{10}$

Hexadecimal equivalent: $(FFFF)_{16}$

- b. Convert $(333)_{10}$ and $(25.625)_{10}$ into binary, octal and hexadecimal.

$(333)_{10} = (14D)_{16} = (515)_8 = (101001101)_2$

$(25.625)_{10} = (19.5)_{16} = (31)_8 = (11001\ 333)_2$

- c. Perform subtraction on the given unsigned decimal numbers by using the 10's complement. Where the result should be negative, find its 10's complement and affix a minus. Consider sign extension with 10s complement arithmetic. Show your work.

23 - 47

Note: Consider sign extension with 10s complement arithmetic.

$023 + (10s\ compl)\ of\ 047 = 023 + 953 = 976 = -(10s\ compl)\ of\ 976 = -24$

- d. Perform subtraction on the given unsigned binary numbers by using the 2's complement. Where the result should be negative, find its 2's complement and affix a minus. Consider sign extension with 2s complement arithmetic. Show your work.

1001 - 110101

Note: Consider sign extension with 2s complement arithmetic.

$01001 + (2s\ compl)\ of\ 0110101 = 0001001 + 1001011 = 1010100 = -(2s\ compl)\ of\ 1010100 = -0101100 = -44$

Question 2

The solutions to the quadratic equation $x^2 - 13x + 32 = 0$ are $x = 4$ and $x = 5$. What is the base of the numbers? Show your work.

$$(x-4)(x-5) = 0, x^2 - 9x + 20 = 0$$

$$13 = b+3 = 9 \text{ so } b=6$$

Question 3

Determine the base of the numbers in each case for the following operations to be correct:

a. $20_3 = 6$

$2b+0_3 = 6$ so $b = 9$

b. $12+24=40$

$b+2 + 2b+4 = 4b$ so $b = 6$

Question 4

Simplify the following Boolean expressions to a minimum number of literals:

a. $(x+y)'(x'+y')$

$x'y'$

b. $(a' + c')(a + b' + c')$

$a'b' + c'$

c. $x'yz + xz$

$xz + yz$

Question 5

Simplify the following expressions to (1) sum-of-products and (2) products-of-sums:

$x'z' + y'z' + yz' + xy$

SOP : $z' + xy$

POS: $(z'+x)(z'+y)$

Question 6

Draw the logic diagram corresponding to the following Boolean expressions by using NAND gates without simplifying them:

a. $(AB + A'B')(CD' + C'D)$

b. $A + CD + (A + D')(C' + D)$

Question 7

Convert the following Boolean function from a sum-of-products form to a simplified product-of-sums form.

$$F(w,x,y,z) = \sum(0,1,2,5,8,10,13)$$

Question 8

Simplify the following function and implement them with two-level NOR gate circuits:

$$F(w,x,y,z) = \sum(0,3,12,15)$$