

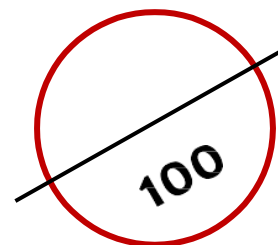
## ECE 2029 Introduction to Digital Circuit Design

## HOMEWORK # 1

**Due:** Submit on CANVAS by 2 pm on Friday, April 3rd

Student Name: \_\_\_\_\_

Date: \_\_\_\_\_



| Problems | Score | Instructor/TA's Comments |
|----------|-------|--------------------------|
| 1)       | /10   |                          |
| 2)       | /10   |                          |
| 3)       | /20   |                          |
| 4)       | /40   |                          |
| 5)       | /10   |                          |
| 6)       | /10   |                          |
| Total    | /100  |                          |

TA's/Instructor's Signature: \_\_\_\_\_ Date: \_\_\_\_\_

**Important (TIPS)**

1. Print this HW sheet and do your work here. Staple extra sheet in case you need more space to show your work.
2. **Show all the process work neatly, don't just jump to answer.** Partial credit may be given. **Box/highlight your answer.**
3. Read the problem carefully, don't assume. Look for the simple, straightforward way to solve the problem. Don't overdo yourself.
4. To make the grading easier, please return your homework on this problem sheet.
5. If you need to use an extra piece of paper, please staple it on and number your solutions just like below!
6. Please turn it into the ECE2029 box located at the ECE department office AK202 above the shelf just when you walk-in. Don't forget to put your mailbox number.

**Problem 1 - 10 points total**

Express the numbers given, in binary form (using the ordinary, and NOT 2's complement, positive only binary positional number system)

$$(a) (3D)_{16}$$

$$(b) (63)_8$$

$$(c) (AC)_{16}$$

$$(d) (24)_5$$

$$(e) (2345)_{16}$$

$$(f) (3255)_8$$

$$(g) (ACFE)_{16}$$

$$(h) (29)_{10}$$

$$(i) (C4D278)_{16}$$

$$(j) (4156)_8$$

### Problem 2 -20 points total

Express the numbers given, in binary form (using the ordinary, and NOT 2's complement, positive only binary positional number system). Perform the conversion using the method of repeated division or repeated multiplication as appropriate, showing all steps.

(a)  $(3.703125)_{10}$

$$(\quad)_2$$

(b)  $(12.5078125)_{10}$

$$\left( \begin{array}{c} \text{ } \end{array} \right)_2$$

**Problem 3 -20 points total**

Convert the following numbers (which are given in ordinary “unsigned” positional number system and not 2’s complement format) to decimal values:

(a)  $(C.82)_{16}$

(b)  $(14.404)_8$

(                      )<sub>10</sub>

(                      )<sub>10</sub>

(c)  $(11101.110011...)_{2}$

(d)  $(11001.0001)_{2}$

(                      )<sub>10</sub>

(                      )<sub>10</sub>

**Problem 4 – 40 points total**

(a) Complete the table below:

[5 pts]

Range: n-bit unsigned and signed (2's complement) numbers

|                | 2-bit | 3-bit | 4-bit | 8-bit | 16-bit |
|----------------|-------|-------|-------|-------|--------|
| Unsigned       |       |       |       |       |        |
| 2's Complement |       |       |       |       |        |

(b) Add -118 and -32 firstly using 8-bit 2's complement arithmetic and then using 16-bit 2's complement arithmetic, **Comment on the results.**

[20 pts]

- (c) Perform the indicated arithmetic on the following **signed two's complement** binary numbers.  
[15 pts]

Your answer should show the two's complement binary result; also indicate if each result is positive or negative or overflowed (writing out **“positive”, “negative” or “overflow” next to the binary answer**) and then follow with the decimal value of the result if there was no overflow. Do not extend (add any additional length) to these representations, but rather use a binary number word size equal to those found in each problem statement.

(i)  $01011011 + 11100101$

(ii)  $01001 - 01110$

(iii)  $1111 + 1100$

**Problem 5 – 10 points total**

- (a) Perform the following decimal arithmetic problems by first converting the numbers to binary, 2's complement form (using a 7 bit word in every case). Then perform the 2's complement addition. Show the result in binary indicating as in the problem above whether each result is positive or negative or overflowed (writing out "positive", "negative" or "overflow" next to the binary answer) and then follow with the decimal value of the result if there was no overflow.

(i)  $13 - 9$

(ii)  $-13 - 13$

**Problem 6 – 10 points total**

Fill the table below:

**4-bit signed binary number comparison**

| Decimal | Signed Magnitude | Signed 1's Complement | Signed 2's Complement |
|---------|------------------|-----------------------|-----------------------|
| +7      |                  |                       |                       |
| +6      |                  |                       |                       |
| +5      |                  |                       |                       |
| +4      |                  |                       |                       |
| +3      |                  |                       |                       |
| +2      |                  |                       |                       |
| +1      |                  |                       |                       |
| +0      |                  |                       |                       |
| -0      |                  |                       |                       |
| -1      |                  |                       |                       |
| -2      |                  |                       |                       |
| -3      |                  |                       |                       |
| -4      |                  |                       |                       |
| -5      |                  |                       |                       |
| -6      |                  |                       |                       |
| -7      |                  |                       |                       |