

Introduction to Digital Design: Exam I

Time: 50 minutes

Total points: 50

Do NOT seek help from others. Ask the exam proctor if you have any questions. Show all steps with your solutions for full credits. Use additional papers if needed. Make sure you write your name on each page and return all of them.

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- 1. (2+2+2 points) Convert the decimal number 125
 - a. Binary
 - b. Octal
 - c. Hexadecimal

Show your work

$$125/2 = 62 \text{ r} \text{ LSB}$$

$$62/2 = 31 \text{ r} \text{ o}$$

$$31/2 = 15 \text{ r} \text{ l}$$

$$15/2 = 7 \text{ r} \text{ l}$$

$$15/2 = 3 \text{ r} \text{ l}$$

$$3/2 = 1 \text{ r} \text{ l}$$

$$3/2 = 0 \text{ r} \text{ l} \text{ MSB}$$

$$570p$$

Binary _	1111012	
Ootol	175%	

Hexadecimal 7D16

2. (4+4+2 points) What is the maximum and minimum (Signed 2's complement) binary number that can be expressed with 7 bits? Convert the maximum binary number into hexadecimal number.

Maximum no. with 7 bits =
$$(2^{(n-1)}1) = (2^{(n-1)}1) = 2^{6-1}$$

= $64-1 = 63$

Maximum Binary (base 2): OIII II /2

Minimum Binary (base 2): 100000

Hexadecimal equivalent of maximum binary 3F16

3. (2+2 points) Show how the decimal numbers below are stored in 2's complement format? (8 bits)

a. +29
$$2^{7}z^{6}z^{5}z^{4}z^{3}z^{2}z^{2}$$

 $0 0 0 1 1 1 0 1 \longrightarrow +29$

b. 49 00110001
$$\rightarrow$$
+49
11001110 \rightarrow Invert the bits
+1 \rightarrow Add 1

4. ((1+1+1+1+1) * 2) Points) Add the two pairs of 6-bit <u>signed (2's complement)</u> numbers. Show the both operands and the result of each addition in decimal as well as binary. Indicate if there is overflow.

b.
$$110011 \longrightarrow -13$$

$$110100 \longrightarrow -12$$

$$100111 \longrightarrow -25$$

5. (10 points) For each of the following pairs of integers, subtract the second from the first. Show the operands and the answers in decimal. Indicate overflow where appropriate

b.
$$100100 \longrightarrow -28$$

$$011000 \longrightarrow +24$$

$$-28 - (+24)$$

$$= -28 + (-24)$$

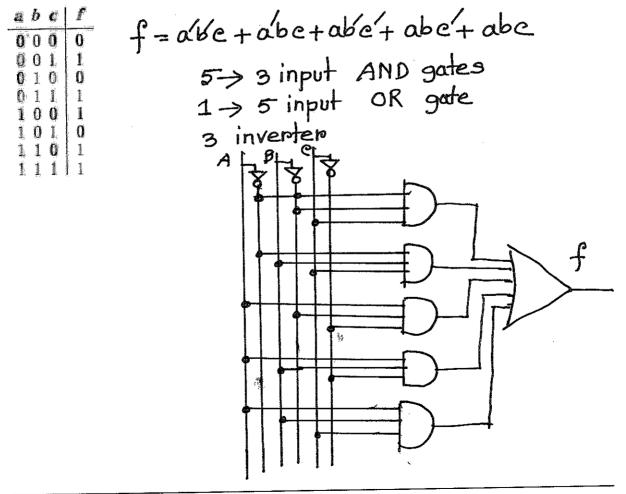
$$011000 \longrightarrow +24$$

$$101000 (-24)$$

$$\begin{array}{c} 100100 \longrightarrow -28 \\ 101000 \longrightarrow -24 \\ \hline 001100 \longrightarrow -52 \end{array}$$

Looks like +12; should be -52; overflow. Sum of two negative numbers look posit

6. (4+6 Points) Derive the logical expression from the truth table. Specify the number of gates and inputs (e.g. 2-input AND) for the functions. Draw the circuit diagram.



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