ECE255 – Introduction to Digital Logic Design
Homework Assignment 2
Due September 18

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NOTE: Some questions require drawing schematics. You can use Logisim Evolution for drawing a schematic and then take a screenshot. Please see the Logisim Tutorial on Canvas as needed.

Let $ABCD_2$ be a 4-bit non-negative integer with corresponding decimal values:

$0000_2 = 0_{10}$
$0001_2 = 1_{10}$
$0010_2 = 2_{10}$
$0011_2 = 3_{10}$
…
$1111_2 = 15_{10}$

The digits *A*, *B*, *C*, and *D* in this 4-bit integer are also to be considered variables. Consider two functions of these 4 variables *f*(*A*, *B*, *C*, *D*) and *g*(*A*, *B*, *C*, *D*).

1. The function *f*(*A*, *B*, *C*, *D*) is defined as:

$$f = \begin{cases} 1 & \text{if the hex value of } ABCD_2 \text{ is less than } A_{16} \\ 0 & \text{otherwise} \end{cases}$$

Describe *f* in the following forms listed below:

(a) **Truth Table**
(b) **CSOP** in the concise $\sum m_i$ **notation**
(c) **CPOS** in the concise $\prod M_i$ **notation**

2. The function $g(A, B, C, D)$ is defined as:

$$g = \begin{cases} 0 & if\ f = 1 \\ 1 & if\ f = 0 \end{cases}$$

Describe g in the following forms listed below:

(a) **CSOP** in the concise $\sum m_i$ **notation**
(b) **CPOS** in the concise $\prod M_i$ **notation**

3. Express the function $f(A, B, C, D)$ in the following forms:

(a) A **Boolean Algebra expression of the CSOP** function $f(A, B, C, D)$
(b) A **minimized Boolean expression** for $f(A, B, C, D)$
Use the properties and axioms of Boolean Algebra to minimize $f(A, B, C, D)$

4. Express ***f(A, B, C, D)*** **as a digital logic schematic**, clearly showing AND, NOT, and OR gates used and how they are connected. **Draw by hand or use Logisim to place and connect gates**.