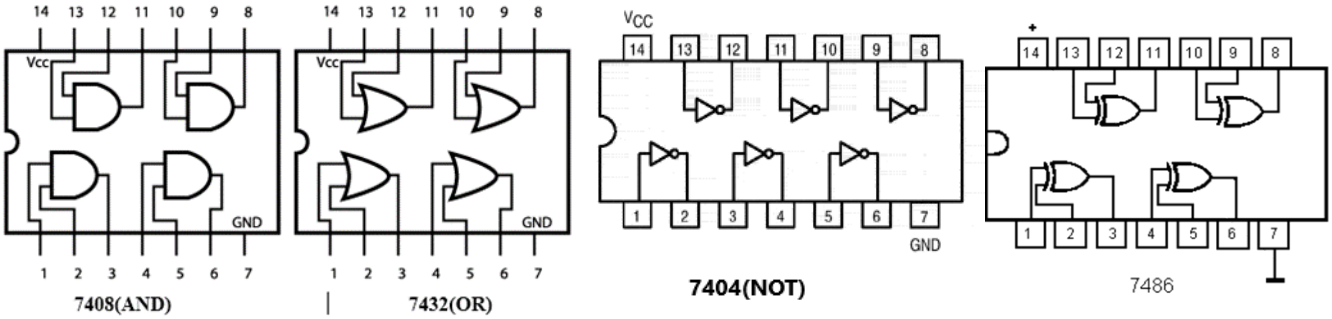
Lab 4 Logic Design and Simplification with K-Maps

The objective of this lab is to design, minimize and implement a 3-bit binary to excess-3 converter circuit using Karnaugh maps.

Equipment: Elenco Digital/Analog Trainer X-150, **Chips:** 74HCT**08** Quad 2-input AND gate, 74HCT**32** Quad 2-input OR gate, 74HCT**04** inverter, 74HCT**86** Quad 2-input XOR gate



Procedure

Computers can accept only binary values whereas we usually need to work with decimal numbers. Therefore, we must represent the decimal digits by means of a code that contains 1's and 0's in order for computers to understand the values and perform operations using them. Other than the commonly used binary code, BCD code, 2421 code, excess-3 code and Gray code are also popular. **Excess-3 is an unweighted code in which each coded combination is obtained from the corresponding binary value plus 3.** In this lab you will design, minimize and implement **a circuit to covert 3-bit binary code to excess-3 code.** The K-map method will be used to minimize Boolean functions.

1. Derive the truth table for a 3-bit binary to excess-3 code converter (wrapping back to '000' maximum input value).

x y z	A B C (= x y z + 3)
0 0 0	
0 0 1	
0 1 0	
0 1 1	
1 0 0	
1 0 1	
1 1 0	
1 1 1	

2. Draw **3** **K-maps**, one for each output and obtain the simplified Boolean equations for A, B, and C.

3. Draw the logic circuit diagram. (The diagram contains 3 inputs to 3 outputs.)

4. Implement the circuit as shown in the circuit diagram on the trainer breadboard and test the circuit. **Test one output at a time.**

When your circuit is working, ask me to check your work.

5. Homework: Design, minimize and implement a 3-bit binary to Gray code converter on TinkerCad. Include the truth table, k-maps, simplified equations, logic diagram, screenshot of your circuit and the link to your Tinkercad circuit in your lab report. Use the CSC 347 Tinkercad starter to build the circuit. Log into Tinkercad, copy and paste the following link to your web browser https://www.tinkercad.com/things/19XqriP2dMF. Click on the button of "Copy and Tinker" on the right to make a copy).

Lab report submission

Lab report is needed for this lab. Please follow the guidelines and sample report on the Blackboard when you are writing your lab report. Click on **Submit Lab 4 Report and HW** to submit your report and homework. It is due one week after the lab is done.