EE 2000 Logic Circuit Design
Semester B 2022/23

Tutorial 1

1. Simplify the following expressions using boolean algebra

   (a) $f(w,x,y,z) = xy + \bar{w}\bar{y}z + \bar{w}x\bar{y} + wxy\bar{z} + \bar{w}yz + wz$

   (b) $f(x,y,z) = (x+y+z)(x+y+\bar{z})(x+\bar{y}+z)(x+\bar{y}+\bar{z})$

   (c) $f(a,b,c,d) = ab + bcd + ab'c' + abd + bc + abc'$

   (d) $f(a,b,c) = (a+b+c)\left(a+\bar{b}+c\right)\left(a+\bar{b}+\bar{c}\right)\left(\bar{a}+\bar{b}+\bar{c}\right)$

2. Given a function $f(x,y,z) = \sum m(0,2,4,6)$

   (a) Show the truth table.

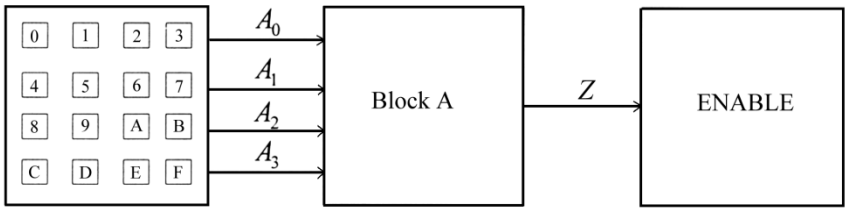
   (b) Show the algebraic expression in standard SOP form.

   (c) Show the minimum SOP expression and draw the circuit diagram.

   (d) Show the algebraic expression in standard POS form.

   (e) Show the minimum POS expression.

3. A simple locker system that has an output signal $Z = 1$ when the hexadecimal keypad input is either 0, 1, 2, 3, 7, 8, 9, A or E; otherwise $Z = 0$. Assume that $A_3\ A_2\ A_1\ A_0$ represent a 4-digit binary number output from the keypad (A_3 as the MSB). Block A decodes these signals and outputs the signal Z.

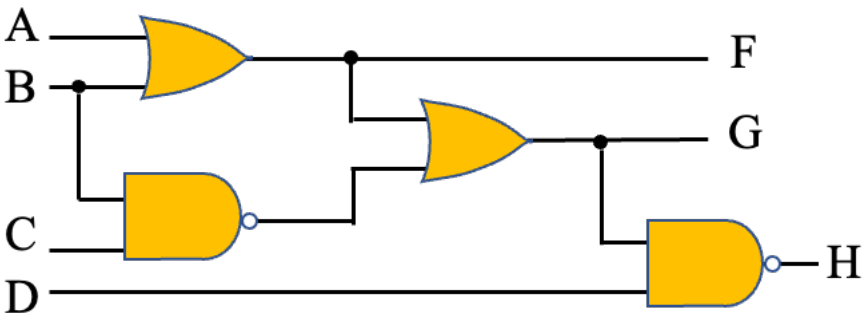


   (a) Write down the truth table of Block A.

   (b) Find the SOP and POS expression of Block A.

   (c) Design the circuit of Block A using minimum number of 2-input AND, OR gates and NOT gates.

4. (a) Derive Boolean functions to describe the operations of the combinational circuit as follow:



(b) Hence, simplify and draw a new logic circuit.

(c) Redraw the logic circuit with only 2-input NAND gates.