EE 2000 Logic Circuit Design
Semester B 2022/23

Assignment 1

1. Simplify the following logic expression using Boolean algebra. (15 marks)

$F = (D + C(AB)')'((AB)'(C + D)')'$

$F = (D + A'C + B'C)'((AB)'C'D')'$

$F = D'(A'C)'(B'C)'(AB + C + D)$

$F = (A + C')(B + C')(ABD' + CD')$

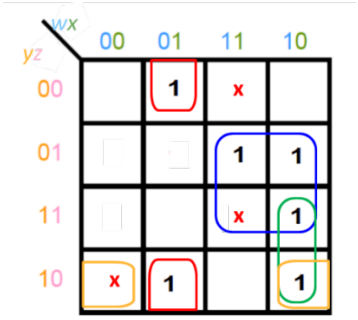
$F = (AB + C')(ABD' + CD')$

$F = ABD' + ABC'D' + ABCD' + CC'D'$

$F = ABD'$

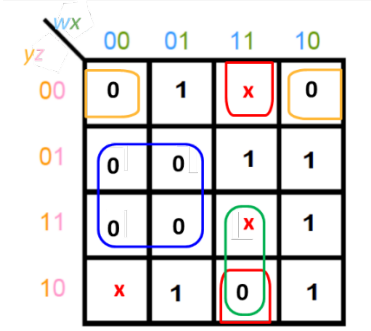
2. Use K-map to find all of the minimum SOP expressions and all of the minimum POS expressions of the following function. If there is more than one solution, label the solutions f_1, f_2,…

$$f(w,x,y,z) = \Sigma m(4,6,9,10,11,13) + \Sigma d(2,12,15)$$ (41 marks)



$f_1(w,x,y,z) = w'xz' + wz + wx'y$

$f_2(w,x,y,z) = w'xz' + wz + x'yz'$



$f_1(w,x,y,z) = (w + z')(x + y + z)(w' + x' + y')$

$f_2(w,x,y,z) = (w + z')(x + y + z)(w' + x' + z)$

3. Use Quine-McCluskey method to find all of the minimum SOP expressions of the following function. If there is more than one solution, label the solutions f_1, f_2,… 4 solutions

$f(w,x,y,z) = \Sigma m(5,7,9,11,13,14) + \Sigma d(2,6,10,12,15)$ (44 marks)

Minterms	*wxyz*
m_2	0010
m_5	0101
m_6	0110
m_9	1001
m_{10}	1010
m_{12}	1100
m_7	0111
m_{11}	1011
m_{13}	1101
m_{14}	1110
m_{15}	1111

Minterms	*wxyz*
m_2, m_6	0-10
m_2, m_{10}	-010
m_5, m_7	01-1
m_5, m_{13}	-101
m_6, m_7	011-
m_6, m_{14}	-110
m_9, m_{11}	10-1
m_9, m_{13}	1-01
m_{10}, m_{11}	101-
m_{10}, m_{14}	1-10
m_{12}, m_{13}	110-
m_{12}, m_{14}	11-0
m_7, m_{15}	-111
m_{11}, m_{15}	1-11
m_{13}, m_{15}	11-1
m_{14}, m_{15}	111-

Minterms	*wzyz*
m_2, m_6, m_{10}, m_{14}	--10 PI_1
m_5, m_7, m_{13}, m_{15}	-1-1 PI_2
m_6, m_7, m_{14}, m_{15}	-11- PI_3
$m_9, m_{11}, m_{13}, m_{15}$	1--1 PI_4
$m_{10}, m_{11}, m_{14}, m_{15}$	1-1- PI_5
$m_{12}, m_{13}, m_{14}, m_{15}$	11-- PI_6

PI	Minterms	*wxyz*	5	7	9	11	13	14
PI_1	m_2, m_6, m_{10}, m_{14}	--10						x
PI_2	m_5, m_7, m_{13}, m_{15}	-1-1	x	x			x	
PI_3	m_6, m_7, m_{14}, m_{15}	-11-		x				x
PI_4	$m_9, m_{11}, m_{13}, m_{15}$	1--1			x	x	x	
PI_5	$m_{10}, m_{11}, m_{14}, m_{15}$	1-1-				x		x
PI_6	$m_{12}, m_{13}, m_{14}, m_{15}$	11--					x	x

$f_1(w,x,y,z) = \mathrm{PI}_1 + \mathrm{PI}_2 + \mathrm{PI}_4 = yz' + xz + wz$

$f_2(w,x,y,z) = \mathrm{PI}_3 + \mathrm{PI}_2 + \mathrm{PI}_4 = xy + xz + wz$

$f_3(w,x,y,z) = \mathrm{PI}_5 + \mathrm{PI}_2 + \mathrm{PI}_4 = wy + xz + wz$

$f_4(w,x,y,z) = \mathrm{PI}_6 + \mathrm{PI}_2 + \mathrm{PI}_4 = wx + xz + wz$