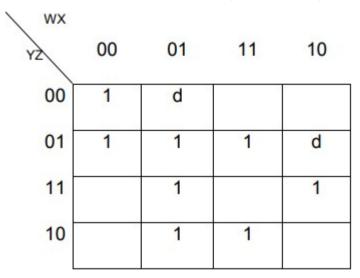
Digital Systems HW 5

Karnaugh Maps

Write the minimal expression corresponding to the following map.
 Indifferent variables are represented by the letter 'd' (don't care).



- 2. Given the following function: $F(a,b,c,d) = \Sigma(1,2,3,11,12,13,14,15) + d(5,7,9)$
 - a) Make a Karnaugh Map.

	a'b'	a'b	ab	ab'
c'd'	0	0	1	0
c'd	1	0	1	0
cd	1	0	1	1
cd'	1	0	1	0

- b) ab + acd + a'b'd + a'b'c
- 3. Reduce the following expressions to SOP and POS forms using Karnaugh maps:
 - a) x'+xyz'+(x+x'y'z)(x(x'+y'+z)')

	x'y'	x'y	ху	xy'
z'	1	1	1	0
Z	1	1	0	0

b) (x+xy)(x+x'z)(y'+yz')+(x(y'+z'))'

	x'y'	x'y	ху	xy'
z,	1	1	1	1
Z	1	1	0	1

4. Reduce the following function to SOP and POS forms using Karnaugh maps: $F(a,b,c,d,e) = \pi(4,6,7,9,11,12,13,14,15,20,22,25,27,28,30) \cdot \pi_0(1,5,29,31)$

a'	b'c'	b'c	bc	bc'	а	b'c'	b'c	bc	bc'
d'e'	1	0	0	1	d'e'	1	0	0	1
d'e	Ф	Ф	0	0	d'e	1	1	Ф	0
de	1	0	0	0	de	1	1	Ф	0
de'	1	0	0	1	de'	1	0	0	1

SOP: b'c' + e'c' + ab'e

а	b+c	b+c'	b'+c'	b'+c	a'	b+c	b+c'	b'+c'	b'+c
d+e	1	0	0	1	d+e	1	0	0	1
d+e'	Ф	Ф	0	0	d+e'	1	1	Ф	0
d'+e'	1	0	0	0	d'+e'	1	1	Ф	0
d'+e	1	0	0	1	d'+e	1	0	0	1

POS: (a+c')(c'+e)(b'+e')

Quine-Mcclusky Tables
1. Reduce the following function to SOP and POS forms using the Quine-Mcclusky method:

F_{abcde}= $\Pi(6, 7, 14, 15, 17, 19, 21, 23, 25, 29) \cdot \Pi_0(1, 5, 9, 13, 18, 22, 30)$ = $\Sigma(0,2,3,4,8,10,11,12,16,20,24,26,27,28,31) + \Sigma_0(1,5,9,13,18,22,30)$

1 00001 0,2 000-0 0,1,4,5 00-0- 0,1,4,5,8,9,12,13 00 2 00010 0,4 00-00 0,1,8,9 0-00- 0,2,8,10,16,18,24,260-			(0, 2, 3)	, T , U , T	0,11,12,10,2	٠, ٢٦, ٢٠	$\mathcal{I}_{\mathcal{I}}$	0, LL, J
2 00010 0,4 00-00 0,1,8,9 0-00 0,2,8,10,16,18,24,260 4 00100 0,8 0-000 0,2,8,10 0-0-0 0,4,8,12,16,20,24,286 8 01000 0,16 -0000 0,2,16,18 -00-0 16,18,20,22,24,26,28,30 1 16 10000 1,3 000-1 0,4,8,12 000 3 00011 1,5 00-01 0,4,16,20 -0-00 5 00101 1,9 0-001 0,8,16,24000 9 01001 2,3 0001- 1,3,9,11 0-0-1 10 01010 2,10 0-010 1,5,9,13 001 12 01100 2,18 -0010 2,3,10,11 0-01- 18 10010 4,5 0010- 2,10,18,26010 20 10100 4,12 0-100 4,5,12,13 0-10- 21 10101 8,9 0100- 8,9,10,11 010 13 01101 8,10 010-0 8,9,12,13 01-0- 21 10110 8,24 -1000 8,12,24,26 -10-0 26 11010 8,24 -1000 8,12,24,26 -10-0 27 11011 16,20 10-00 16,18,20,22 100 27 11011 16,20 10-00 16,18,24,26 1-0-0 30 11110 16,24 1-000 16,20,24,28 100 31 11111 3,11 0-011 10,11,26,27 -101- 5,13 0-101 24,26,28,30 10 9,13 01-01 24,26,28,30 11-0 10,14 0101- 26,27,30,31 11-1 10,26 -1010 12,28 -1100 18,22 10-10 18,22 10-10 18,22 10-10 18,22 10-10 18,22 10-10 18,22 10-10 20,22 101-0 20,28 1-100	0	00000	0,1	0000-	0,1,2,3	000	0,1,2,3,8,9,10,11	0-0
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18,22 10-10 18,26 1-010 20,22 101-0 20,28 1-100			12,13	0110-				
18,26 1-010 20,22 101-0 20,28 1-100			12,28	-1100				
20,22 101-0 20,28 1-100			18,22	10-10				
20,28 1-100			18,26	1-010				
			20,22	101-0				
24,26 110-0			20,28	1-100				
			24,26	110-0				

	24,28	11-00		
	11,27	-1011		
	22,30	1-110		
	26,27	1101-		
	26,30	11-10		
	28,30	111-0		
	27,31	11-11		
	30,31	1111-		

	0	2	3	4	8	10	11	12	16	20	24	26	27	28	31
10,11,26,27						х	x					X	х		
26,27,30,31												X	x		Х
0,1,2,3,8,9,10,11	Х	Х	X		X	х	x								
0,1,4,5,8,9,12,13	Х			X	Х			х							
0,2,8,10,16,18,24,26	Х	Х			Х	х			x		х	X			
0,4,8,12,16,20,24,28	Х			Х	X			х	х	х	х			X	
16,18,20,22,24,26,28,30									х	X	x	X		X	

SOP: F = abd + a'c' + d'e'

		дгоир	d	Group	d	Group	d
1	00001	1,5	4	1,5,9,13	4,8	1,5,9,13,17,21,25,29	4,8,16
5	00101	1,9	8	1,5,17,21	4,16		
6	01010	1,17	16	1,9,17,25	8,16		
9	01001	5,7	2	5,7,13,15	2,8		
17	10001	5,13	8	5,7,21,23	2,16		
18	10010	5,21	16	5,13,21,29	8,16		
7	00111	6,7	1	6,7,14,15	1,8		
13	01101	6,14	8	6,7,22,23	1,16		
14	01110	6,22	16	6,14,22,30	8,16		
19	10011	9,13	4	9,13,25,29	4,16		
21	10101	9,25	16	17,19,21,23	2,4		
22	10110	17,19	2	17,21,25,29	4,8		
25	11001	17,21	4	18,19,22,23	1,4		
15	01111	17,25	8				
23	10111	18,19	1				
29	11101	18,22	4				_
30	11110	7,15	8				
		7,23	16				

	13,15	2		
	13,29	16		
,	14,15	1		
	14,30	16		
	19,23	4		
	21,23	2		
	21,29	8		
	22,23	1		
	22,30	8		
	25,29	4		

		6	7	14	15	17	19	21	23	25	29
	5,7,13,15		х		х						
	5,7,21,23		х					х	х		
0-01-	6,7,14,15	x	x	X	х						
	6,7,22,23	x	х								
	6,14,22,30	x		х							
100	17,19,21,23					Х	х	х	х		
	18,19,22,23						х		х		
01	1,5,9,13,17,21,25,29					Х		х		х	х

POS: (a+c+d')(a'+b+e)(d+e')

2. Given the function: $f(W,X,Y,Z) = \Sigma(0,1,3,5,8,10,11,12) + \Sigma_0(9,14)$ a) What are the prime implicants of the function?

		Group	d	Group	d
0	0000	0,1	1	0,1,8,9	1,8
1	0001	0,8	8	1,3,9,11	2,8
8	1000	1,3	2	8,9,10,11	1,2
3	0011	1,5	4	8,10,12,14	2,4
5	0101	1,9	8		
9	1001	8,9	1		
10	1010	8,10	2		
12	1100	8,12	4		
11	1011	3,11	8		
14	1110	9,11	2		
		10,11	1		
		10,14	4		
		12,14	2		

- PIs are (0,1,8,9), (1,3,9,11), (8,9,10,11), (8,10,12,14) and (1,5) b) What are the Essential Prime Implicants (EPI) of the function? EPIs are (0,1,8,9), (1,3,9,11), (8,10,12,14) and (1,5) c) What is the minimal expression in SOP form?
- x'y'+x'z+wz'+w'y'z