Home Work 12

The problems in this problem set cover lectures C16

1.

a. Using truth tables, show that $\overline{A} \langle\ \overline{B} = \overline{(A+B)}$

A	B	$\overline{A}$	$\overline{B}$	$\overline{A} \langle\ \overline{B}$	$A+B$	$\overline{(A+B)}$
0	0	1	1	1	0	1
0	1	1	0	0	1	0
1	0	0	1	0	1	0
1	1	0	0	0	1	0

b. Using K-Maps, simplify the following expression:

$$\overline{A} \langle\ \overline{B} \langle\ \overline{C} + \overline{A} \langle\ \overline{B} \langle\ C + A \langle\ \overline{B} \langle\ C + A \langle\ \overline{B} \langle\ \overline{C}$$

A	B	C	Minterm
0	0	0	$\overline{A} \langle\ \overline{B} \langle\ \overline{C}$
0	0	1	$\overline{A} \langle\ \overline{B} \langle\ C$
0	1	0	$\overline{A} \langle\ B \langle\ \overline{C}$
0	1	1	$\overline{A} \langle\ B \langle\ C$
1	0	0	$A \langle\ \overline{B} \langle\ \overline{C}$
1	0	1	$A \langle\ \overline{B} \langle\ C$
1	1	0	$A \langle\ B \langle\ \overline{C}$
1	1	1	$A \langle\ B \langle\ C$

C/ AB	00	01	11	10
0	1			1
1	1			1

$$\overline{A} \langle\ \overline{B} \langle\ \overline{C} + \overline{A} \langle\ \overline{B} \langle\ C + A \langle\ \overline{B} \langle\ C + A \langle\ \overline{B} \langle\ \overline{C} = \overline{B}$$

c. Using K-Maps, simplify the following expression:

$$A\langle B\langle D+\overline{B}\langle C\langle D+\overline{A}\langle B\langle C\langle D+\overline{C}\langle D$$

A	B	C	D	Minterm
0	0	0	0	$\overline{A}\langle \overline{B}\langle \overline{C}\langle \overline{D}$
0	0	0	1	$\overline{A}\langle \overline{B}\langle \overline{C}\langle D$
0	0	1	0	$\overline{A}\langle \overline{B}\langle C\langle \overline{D}$
0	0	1	1	$\overline{A}\langle \overline{B}\langle C\langle D$
0	1	0	0	$\overline{A}\langle B\langle \overline{C}\langle \overline{D}$
0	1	0	1	$\overline{A}\langle B\langle \overline{C}\langle D$
0	1	1	0	$\overline{A}\langle B\langle C\langle \overline{D}$
0	1	1	1	$\overline{A}\langle B\langle C\langle D$
1	0	0	0	$A\langle \overline{B}\langle \overline{C}\langle \overline{D}$
1	0	0	1	$A\langle \overline{B}\langle \overline{C}\langle D$
1	0	1	0	$A\langle \overline{B}\langle C\langle \overline{D}$
1	0	1	1	$A\langle \overline{B}\langle C\langle D$
1	1	0	0	$A\langle B\langle \overline{C}\langle \overline{D}$
1	1	0	1	$A\langle B\langle \overline{C}\langle D$
1	1	1	0	$A\langle B\langle C\langle \overline{D}$
1	1	1	1	$A\langle B\langle C\langle D$

CD/ AB	00	01	11	10
00	0	0	0	0
01	1	1	1	1
11	1	1	1	1
10	0	0	0	0

$$A\langle B\langle D+\overline{B}\langle C\langle D+\overline{A}\langle B\langle C\langle D+\overline{C}\langle D=D$$

d. Simplify the same expression using the rules of simplification.

$A\langle\, B\langle\, D + \overline{B}\langle\, C\langle\, D + \overline{A}\langle\, B\langle\, C\langle\, D + \overline{C}\langle\, D$

$B\langle\, D(A + \overline{A}C) + D(\overline{B}\langle\, C + \overline{C})$	[Distributive Property]
$B\langle\, D\langle\, (A + C) + D(\overline{B} + \overline{C})$	[Two Value Theorem]
$A\langle\, B\langle\, D + B\langle\, C\langle\, D + D\langle\, \overline{B} + D\langle\, \overline{C}$	[Distributive Property]
$D(AB + \overline{B}) + D(BC + \overline{C})$	[Distributive Property]
$D(A + \overline{B}) + D(B + \overline{C})$	[Two Value Theorem]
$D\langle\, A + D\langle\, \overline{B} + D\langle\, B + D\langle\, \overline{C}$	[Distributive Property]
$D\langle\, A + D(B\langle\, \overline{B}) + D\langle\, \overline{C}$	[Distributive Property]
$D\langle\, A + D\langle\, 1 + D\langle\, \overline{C}$	[Single Value Theorem]
$(D\langle\, A + D) + D\langle\, \overline{C}$	[Two Value Theorem]
$D + D\langle\, \overline{C}$	[Single Value Theorem]
D	[Single Value Theorem]

2. Convert the following expression into product of sum form:

$$\overline{A}\langle\, \overline{B}\langle\, \overline{C} + \overline{A}\langle\, B\langle\, C + A\langle\, B\langle\, \overline{C} + A\langle\, \overline{B}\langle\, C$$

A	B	C	Minterm
0	0	0	$\overline{A}\langle\, \overline{B}\langle\, \overline{C}$
0	0	1	$\overline{A}\langle\, \overline{B}\langle\, C$
0	1	0	$\overline{A}\langle\, B\langle\, \overline{C}$
0	1	1	$\overline{A}\langle\, B\langle\, C$
1	0	0	$A\langle\, \overline{B}\langle\, \overline{C}$
1	0	1	$A\langle\, \overline{B}\langle\, C$
1	1	0	$A\langle\, B\langle\, \overline{C}$
1	1	1	$A\langle\, B\langle\, C$

$$\overline{A}\langle\,\overline{B}\langle\,\overline{C}+\overline{A}\langle\,B\langle\,C+A\langle\,B\langle\,\overline{C}+A\langle\,\overline{B}\langle\,C$$

C/ AB	00	01	11	10
0	1	0	1	0
1	0	1	0	1

$$=\overline{\overline{(\overline{A}\langle\,\overline{B}\langle\,C+\overline{A}\langle\,B\langle\,\overline{C}+A\langle\,B\langle\,C+A\langle\,\overline{B}\langle\,\overline{C})}}$$

$$=(A+B+\overline{C})\langle(A+\overline{B}+C)\langle\,(\overline{A}+\overline{B}+\overline{C})\langle\,(\overline{A}+B+C)$$