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Homework - 6

5.1

A	B	$(A \vee B)$	$\neg A$	$\neg A \to B$
0	0	0	1	0
0	1	1	1	1
1	0	1	0	1
1	1	1	0	1

$(\neg A \to B) == (A \vee B)$

A	B	$(A \wedge B)$	$\neg B$	$A \to \neg B$	$\neg(A \to \neg B)$
0	0	0	1	1	0
0	1	0	0	1	0
1	0	0	1	1	0
1	1	1	0	0	1

$\neg(A \to \neg B) == (A \wedge B)$

A	$\neg A$	$(A \to \neg A)$
0	1	1
1	0	0

$(A \to \neg A) == \neg A$

Scanned with CamScanner

6.2 (a) $e(A, B) = (\neg A \vee \neg B) \wedge (\neg A \vee B) \wedge (A \wedge \neg B)$

Representing ($\neg$) with ($-$) bar, ($\vee$) with $+$, ($\wedge$) with ($\cdot$).

$$(\bar{A} + \bar{B}) \cdot (\bar{A} + B) \cdot (A + \bar{B})$$

$$\bar{A} + (\bar{B} \cdot B) \cdot (A + \bar{B}) \qquad \text{(distributivity)}$$

$$\bar{A} + (0) \cdot (A + \bar{B}) \qquad \text{(complementarity)}$$

$\bar{A} \cdot (A + \bar{B})$

$(\bar{A} \cdot A) + (\bar{A} \cdot \bar{B})$ (distributivity)

$0 + (\bar{A} \cdot \bar{B})$ (complementarity)

$(\bar{A} \cdot \bar{B}) - (\neg A \wedge \neg B)$

(b) $e(A,B,C) = (A \wedge \neg B) \vee (A \wedge \neg B \wedge C)$

$(A \cdot \bar{B}) + (A \cdot \bar{B} \cdot C)$

~~$(A \cdot \bar{B}) \cdot (\bar{B} +$~~

$(A \cdot \bar{B} + A \cdot \bar{B}) \cdot (A \cdot \bar{B} + C)$ [distributivity]

$(A \cdot \bar{B}) \cdot (A \cdot \bar{B} + C)$ (idempotence)

$A \cdot \bar{B}$ (Absorption)

$(A \wedge \neg B)$

(c) $e(A, B, C, D) = (A \vee \neg(B \wedge A)) \wedge (C \vee (D \vee C))$

$(A + (\bar{B} + \bar{A})) \cdot (C + (D + C))$ (de morgan's)

$(A + (\bar{A} + \bar{B})) \cdot (C + (C + D))$ (Commutativity)

$((A + \bar{A}) + \bar{B}) \cdot ((C + C) + D)$ (associativity)

$(1+\bar{B}) \cdot ((C)+D)$ (complementarity)

$(1+\bar{B}) \cdot (C+D)$ (idempotence)

$1 \cdot (C+D)$ (identity)

$(C+D) = (C \vee D)$

(d) $e(A,B,C) = (\neg(A \wedge B) \vee \neg C) \wedge (\neg A \vee B \vee \neg C)$

$((\bar{A}+\bar{B})+\bar{C}) \cdot (\bar{A}+B+\bar{C})$ (de morgan's)

$(\bar{A}+(\bar{B}+\bar{C})) \cdot (\bar{A}+B+\bar{C})$ (associativity)

$(\bar{A}+(\bar{C}+\bar{B})) \cdot (\bar{A}+B+\bar{C})$ (commutativity)

$((\bar{A}+\bar{C})+\bar{B}) \cdot (\bar{A}+B+\bar{C})$ (associativity)

$\bar{A}+\bar{C}+(\bar{B} \cdot B)$ (distributivity)

$(\bar{A}+\bar{C})$ (complementarity)

$(\neg A \vee \neg C)$

(e) $e(A,B) = (A \vee B) \wedge (\neg A \vee B) \wedge (A \vee \neg B) \wedge (\neg A \vee \neg B)$

$(A+B) \cdot (\bar{A}+B) \cdot (A+\bar{B}) \cdot (\bar{A}+\bar{B})$

$A+(B \cdot \bar{B}) \cdot (\bar{A}+B) \cdot (\bar{A}+\bar{B})$ (distributivity)

$A+(0) \cdot (\bar{A}+B) \cdot (\bar{A}+\bar{B})$ (complementarity)

$A \cdot \bar{A} + (B \cdot \bar{B})$ (distributivity)

$A \cdot \bar{A} + (0)$ (complementarity)

0 (complementarity)

6.3 $e(P, Q, R, S) = (\neg P \vee Q) \wedge (\neg Q \vee R) \wedge (\neg R \vee S) \wedge (\neg$

Making a truth table

P	Q	R	S	e
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	0
0	1	0	0	0
0	1	0	1	0
0	1	1	0	0
0	1	1	1	0
1	0	0	0	0
1	0	0	1	0
1	0	1	0	0
1	0	1	1	0
1	1	0	0	0
1	1	0	1	0
1	1	1	0	0
1	1	1	1	1

Therefore condition is satisfied in only 2 interpretation.

(b) $(\neg P \wedge \neg Q \wedge \neg R \wedge \neg S) \vee (P \wedge Q \wedge R \wedge S)$

(DNF) form.