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Logic design (Fall 2021)
Quiz # 3

Name:_____ID:_____

1. (50%) Eliminate the exclusive OR, and then factor to obtain a minimum product of sums.

A'(B⊕C')+AC+B'C

Ans:

A'(B⊕C')+AC+B'C

=A'(BC+B'C')+AC+B'C

=A'BC+A'B'C'+AC+B'C

=C(A'B+A+B')+C'(A'B')

=(A'B+A+B'+C')(A'B'+C)

=(A'+A+B'+C')(B+A+B'+C')(A'+C)(B'+C)

=(A'+C)(B'+C)

Z'(Y⊕X')+ZX+Y'X

Ans:

Z'(Y⊕X')+ZX+Y'X

=Z'(YX+Y'X')+ZX+Y'X

=Z'YX+Z'Y'X'+ZX+Y'X

=X(Z'Y+Z+Y')+X'(Z'Y')

=(Z'Y+Z+Y'+X')(Z'Y'+X)

=(Z'+Z+Y'+X')(Y+Z+Y'+X')(Z'+X)(Y'+X)

=(Z'+X)(Y'+X)

Q'(P⊕R')+QR+P'R

Ans:

Q'(P⊕R')+QR+P'R

=Q'(PR+P'R')+QR+P'R

=Q'PR+Q'P'R'+QR+P'R

=R(Q'P+Q+P')+R'(Q'P')

=(Q'P+Q+P'+R')(Q'P'+R)

=(Q'+Q+P'+R')(P+Q+P'+R')(Q'+R)(P'+R)

=(Q'+R)(P'+R)

2. (50%) Determine the following equation is always valid or not with algebraic proof. Please reduce both sides to a sum of products.
   (20%) (a) LHS = ?
   (30%) (b) RHS = ? Is the original equation valid? (Hint: Remember to use consensus theorem)

$$(A'+B')(A\oplus C)+(A+C)(B\equiv C) = A'C+A(B\equiv C)$$

Ans:

(a)

LHS = (A'+B')(AC'+A'C)+(A+C)(BC+B'C')

=(A'C+AB'C'+~~A'B'C~~)+(~~ABC~~+~~AB'C'~~+BC)

=A'C+AB'C'+BC

(b)

RHS = A'C+ABC+AB'C'

=A'C+ABC+AB'C'+BC (add BC by consensus theorem)

=A'C+AB'C'+BC (eliminate ABC by BC)

The original equation is valid!

$$(Z'+Y')(Z\oplus X)+(Z+X)(Y\equiv X) = Z'X+Z(Y\equiv X)$$

Ans:

(a)

LHS = (Z'+Y')(ZX'+Z'X)+(Z+X)(YX+Y'X')

=(Z'X+ZY'X'+~~Z'Y'X~~)+(~~ZYX~~+~~ZY'X'~~+YX)

=Z'X+ZY'X'+YX

(b)

RHS = Z'X+ZYX+ZY'X'

=Z'X+ZYX+ZY'X'+YX (add YX by consensus theorem)

=Z'X+ZY'X'+YX (eliminate ZYX by YX)

The original equation is valid!

$(Q'+P')(Q\oplus R)+(Q+R)(P\equiv R) = Q'R+Q(P\equiv R)$

Ans:

(a)

LHS = (Q'+P')(QR'+Q'R)+(Q+R)(PR+P'R')

=(Q'R+QP'R'+~~Q'P'R~~)+(~~QPR~~+~~QP'R'~~+PR)

=Q'R+QP'R'+PR

(b)

RHS = Q'R+QPR+QP'R'

=Q'R+QPR+QP'R'+PR (add PR by consensus theorem)

=Q'R+QP'R'+PR (eliminate QPR by PR)

The original equation is valid!