

Solutions Manual for Fundamentals of Logic Design Enhanced Edition 7th Roth

SOLUTIONS MANUAL SAMPLE PREVIEW

PUBLISHER

Cengage

COPYRIGHT

2021

ISBN

9781337620352

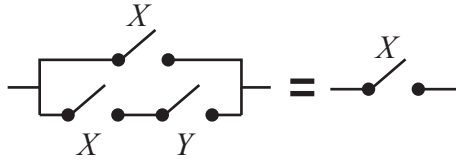
RESOURCE TYPE

Solutions Manual

Unit 2 Problem Solutions

2.1 See FLD p. 731 for solution.

2.2 (a) In both cases, if $X = 0$, the transmission is 0, and if $X = 1$, the transmission is 1.



2.3 Answer is in FLD p. 731

2.4 (a) $F = [(A \cdot 1) + (A \cdot 1)] + E + BCD = A + E + BCD$

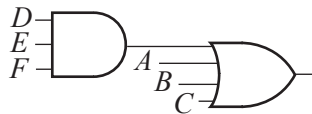
2.5 (a) $(A + B)(C + B)(D' + B)(ACD' + E)$
 $= (AC + B)(D' + B)(ACD' + E)$ By Dist. Law
 $= (ACD' + B)(ACD' + E)$ By Dist. Law
 $= ACD' + BE$ By Dist. Law

2.6 (a) $AB + C'D' = (AB + C')(AB + D')$
 $= (A + C')(B + C')(A + D')(B + D')$

2.6 (c) $A'BC + EF + DEF' = A'BC + E(F + DF')$
 $= A'BC + E(F + D) = (A'BC + E)(A'BC + F + D)$
 $= (A' + E)(B + E)(C + E)(A' + F + D)$
 $(B + F + D)(C + F + D)$

2.6 (e) $ACD' + C'D' + A'C = D'(AC + C') + A'C$
 $= D'(A + C') + A'C$ By Elimination Theorem
 $= (D' + A'C)(A + C' + A'C)$
 $= (D' + A')(D' + C)(A + C' + A')$
 By Distributive Law and Elimination Theorem
 $= (A' + D')(C + D')$

2.7 (a) $(A + B + C + D)(A + B + C + E)(A + B + C + F)$
 $= A + B + C + DEF$
 Apply second Distributive Law twice

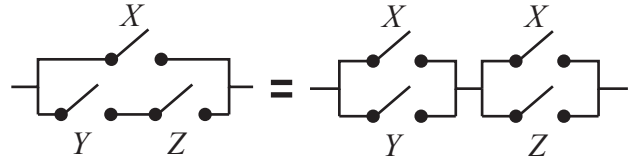


2.8 (a) $[(AB)' + C'D]' = AB(C'D)' = AB(C + D')$
 $= ABC + ABD'$

2.8 (c) $((A + B')C')(A + B)(C + A)'$
 $= (A'B + C')(A + B)C'A' = (A'B + C')A'BC'$
 $= A'BC'$

2.9 (a) $F = [(A + B)' + (A + (A + B)')](A + (A + B)')'$
 $= (A + (A + B)')'$
 By Elimination Theorem with
 $X = (A + (A + B)')' = A'(A + B) = A'B$

2.2 (b) In both cases, if $X = 0$, the transmission is YZ , and if $X = 1$, the transmission is 1.



2.4 (b) $Y = (AB' + (AB + B))B + A = (AB' + B)B + A$
 $= (A + B)B + A = AB + B + A = A + B$

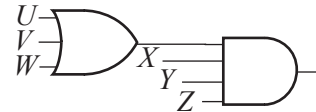
2.5 (b) $(A' + B + C')(A' + C' + D)(B' + D')$
 $= (A' + C' + BD)(B' + D')$
 {By Distributive Law with $X = A' + C'$ }
 $= A'B' + B'C' + B'BD + A'D' + C'D' + BDD'$
 $= A'B' + A'D' + C'B' + C'D'$

2.6 (b) $WX + WY'X + ZYX = X(W + WY' + ZY)$
 $= X(W + ZY)$ {By Absorption}
 $= X(W + Z)(W + Y)$

2.6 (d) $XYZ + W'Z + XQ'Z = Z(XY + W' + XQ')$
 $= Z[W' + X(Y + Q')]$
 $= Z(W' + X)(W' + Y + Q')$ By Distributive Law

2.6 (f) $A + BC + DE$
 $= (A + BC + D)(A + BC + E)$
 $= (A + B + D)(A + C + D)(A + B + E)(A + C + E)$

2.7 (b) $WXYZ + VXYZ + UXYZ = XYZ(W + V + U)$
 By first Distributive Law

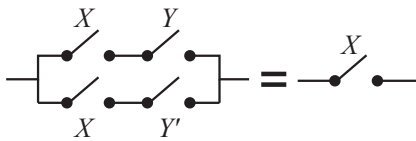


2.8 (b) $[A + B(C' + D)]' = A'(B(C' + D))'$
 $= A'(B' + (C' + D)') = A'(B' + CD')$
 $= A'B' + A'CD'$

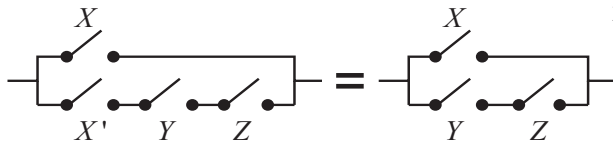
2.9 (b) $G = \{[(R + S + T)' PT(R + S)]' T\}'$
 $= (R + S + T)' PT(R + S)' + T'$
 $= T' + (R'S'T') P(R'S')T = T' + PR'S'T'T = T'$

Unit 2 Solutions

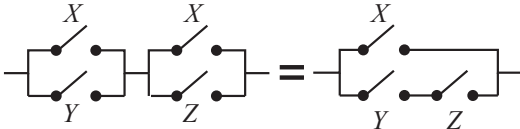
2.10 (a)



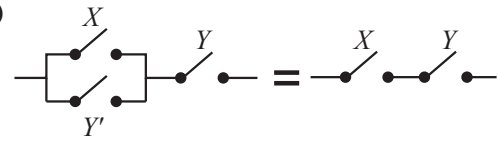
2.10 (c)



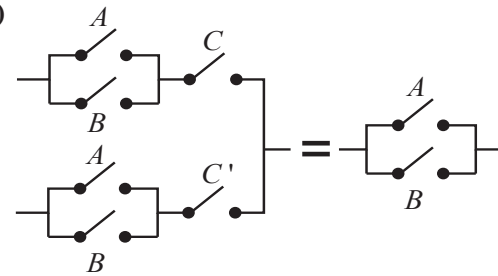
2.10 (e)



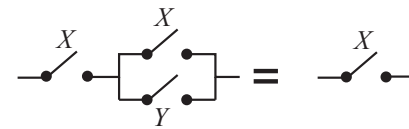
2.10 (b)



2.10 (d)



2.10 (f)



2.11 (a) $(A' + B' + C)(A' + B' + C)' = 0$ By Complementarity Law

2.11 (c) $AB + (C' + D)(AB)' = AB + C' + D$ By Elimination Theorem

2.11 (e) $[AB' + (C + D)' + E'F](C + D) = AB'(C + D) + E'F(C + D)$ Distributive Law

2.12 (a) $(X + Y'Z) + (X + Y'Z)' = 1$ By Complementarity Law

2.12 (c) $(V'W + UX)'(UX + Y + Z + V'W) = (V'W + UX)'(Y + Z)$ By Elimination Theorem

2.12 (e) $(W' + X)(Y + Z') + (W' + X)'(Y + Z') = (Y + Z')$ By Uniting Theorem

2.13 (a) $F_1 = A'A + B + (B + B) = 0 + B + B = B$

2.13 (c) $F_3 = [(AB + C)'D][(AB + C) + D] = (AB + C)'D(AB + C) + (AB + C)'D = (AB + C)'D$ By Absorption

2.14 (a) $ACF(B + E + D)$

2.15 (a) $f' = \{[A + (BCD)][(AD)' + B(C' + A)]\}' = [A + (BCD)][(AD)' + B(C' + A)]' = A'(BCD)'' + (AD)'[B(C' + A)]' = A'BCD + AD[B' + (C' + A)] = A'BCD + AD[B' + C'A] = A'BCD + AD[B' + CA]$

2.16 (a) $f^D = [A + (BCD)][(AD)' + B(C' + A)]^D = [A(B + C + D)][(A + D)'(B + C'A)]$

2.17 (a) $f = [(A' + B')C] + [A(B + C')] = A'C + B'C + AB + AC' = A'C + B'C + AB + AC' + BC = A'C + C + AB + AC' = C + AB + A = C + A$

2.17 (c) $f = (A' + B' + A)(A + C)(A' + B' + C' + B)(B + C + C') = (A + C)$

2.11 (b) $AB(C' + D) + B(C' + D) = B(C' + D)$ By Absorption

2.11 (d) $(A'BF + CD')(A'BF + CEG) = A'BF + CD'EG$ By Distributive Law

2.11 (f) $A'(B + C)(D'E + F)' + (D'E + F) = A'(B + C) + D'E + F$ By Elimination

2.12 (b) $[W + X'(Y + Z)][W' + X'(Y + Z)] = X'(Y + Z)$ By Uniting Theorem

2.12 (d) $(UV' + W'X)(UV' + W'X + Y'Z) = UV' + W'X$ By Absorption Theorem

2.12 (f) $(V' + U + W)[(W + X) + Y + UZ'] + [(W + X) + UZ' + Y] = (W + X) + UZ' + Y$ By Absorption

2.13 (b) $F_2 = A'A' + AB' = A' + AB' = A' + B'$

2.13 (d) $Z = [(A + B)C]' + (A + B)CD = [(A + B)C]' + D$ By Elimination with $X = [(A + B)C]'$
 $= A'B' + C' + D'$

2.14 (b) $W + Y + Z + VUX$

2.15 (b) $f' = [AB'C + (A' + B + D)(ABD' + B')]'$
 $= (AB'C)'[(A' + B + D)(ABD' + B')]'$
 $= (A' + B'' + C')[A'(A' + B + D)' + (ABD')'B'']$
 $= (A' + B + C)[A''B'D' + (A' + B' + D'')B]$
 $= (A' + B + C)[AB'D' + (A' + B' + D)B]$

2.16 (b) $f^D = [AB'C + (A' + B + D)(ABD' + B')]^D = (A + B' + C)[A'BD + (A + B + D')B']$

2.17 (b) $f = A'C + B'C + AB + AC' = A + C$

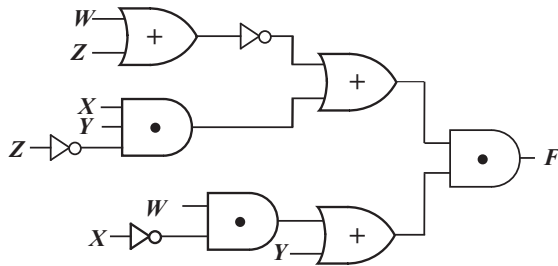
2.18 (a) product term, sum-of-products, product-of-sums

Unit 2 Solutions

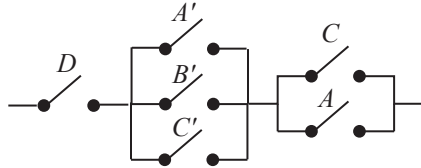
2.18 (b) sum-of-products

2.18 (d) sum term, sum-of-products, product-of-sums

2.19



$$\begin{aligned} 2.20 \text{ (c)} \quad F &= D[(A' + B')C + AC'] \\ &= D(A' + B' + AC')(C + AC') \\ &= D(A' + B' + C')(C + A) \end{aligned}$$



$$\begin{aligned} 2.22 \text{ (a)} \quad A'B' + A'CD + A'DE' \\ &= A'(B' + CD + DE') \\ &= A'[B' + D(C + E')] \\ &= A'(B' + D)(B' + C + E') \end{aligned}$$

$$\begin{aligned} 2.22 \text{ (b)} \quad H'I' + JK \\ &= (H'I' + J)(H'I' + K) \\ &= (H' + J)(I' + J)(H' + K)(I' + K) \end{aligned}$$

$$\begin{aligned} 2.22 \text{ (c)} \quad A'BC + AB'C + CD' \\ &= C(A'B + AB' + D') \\ &= C[(A + B)(A' + B') + D'] \\ &= C(A + B + D')(A' + B' + D') \end{aligned}$$

$$2.23 \text{ (a)} \quad W + U'YV = (W + U')(W + Y)(W + V)$$

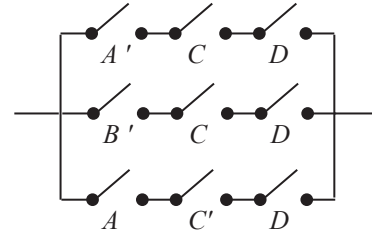
$$\begin{aligned} 2.23 \text{ (c)} \quad A'B'C + B'CD' + B'E' &= B'(A'C + CD' + E') \\ &= B'[E' + C(A' + D')] \\ &= B'(E' + C)(E' + A' + D') \end{aligned}$$

2.18 (c) none apply

2.18 (e) product-of-sums

$$2.20 \text{ (a)} \quad F = D[(A' + B')C + AC']$$

$$\begin{aligned} 2.20 \text{ (b)} \quad F &= D[(A' + B')C + AC'] \\ &= A'CD + B'CD + AC'D \end{aligned}$$



A	B	C	H	F	G
0	0	0	0	0	0
0	0	1	1	1	x
0	1	0	1	0	1
0	1	1	1	1	x
1	0	0	0	0	0
1	0	1	1	0	1
1	1	0	0	0	0
1	1	1	1	1	x

$$\begin{aligned} 2.22 \text{ (d)} \quad A'B' + (CD' + E) &= A'B' + (C + E)(D' + E) \\ &= (A'B' + C + E)(A'B' + D' + E) \\ &= (A' + C + E)(B' + C + E) \\ &\quad (A' + D' + E)(B' + D' + E) \end{aligned}$$

$$\begin{aligned} 2.22 \text{ (e)} \quad A'B'C + B'CD' + EF' &= A'B'C + B'CD' + EF' \\ &= B'C(A' + D') + EF' \\ &= (B'C + EF')(A' + D' + EF') \\ &= (B' + E)(B' + F')(C + E)(C + F') \\ &\quad (A' + D' + E)(A' + D' + F') \end{aligned}$$

$$\begin{aligned} 2.22 \text{ (f)} \quad WX'Y + W'X' + W'Y' &= X'(WY + W') + W'Y' \\ &= X'(W' + Y) + W'Y' \\ &= (X' + W')(X' + Y)(W' + Y + W')(W' + Y + Y') \\ &= (X' + W')(X' + Y)(W' + Y) \end{aligned}$$

$$\begin{aligned} 2.23 \text{ (b)} \quad TW + UY' + V \\ &= (T + U + V)(T + Y' + V)(W + U + V)(W + Y' + V) \end{aligned}$$

$$\begin{aligned} 2.23 \text{ (d)} \quad ABC + ADE' + ABF' &= A(BC + DE' + BF') \\ &= A[DE' + B(C + F')] \\ &= A(DE' + B)(DE' + C + F') \\ &= A(B + D)(B + E')(C + F' + D)(C + F' + E') \end{aligned}$$

Unit 2 Solutions

$$\begin{aligned} 2.24 \text{ (a)} \quad & [(XY)' + (X' + Y)'Z] = X' + Y + (X' + Y)'Z \\ & = X' + Y + Z \text{ By Elimination Theorem with } X \\ & = (X' + Y) \end{aligned}$$

$$\begin{aligned} 2.24 \text{ (c)} \quad & [(A' + B')' + (A'B'C)' + C'D]' \\ & = (A' + B')A'B'C(C + D) = A'B'C \end{aligned}$$

$$\begin{aligned} 2.25 \text{ (a)} \quad & F(P, Q, R, S)' = [(R' + PQ)S]' = R(P' + Q') + S' \\ & = RP' + RQ' + S' \end{aligned}$$

$$\begin{aligned} 2.25 \text{ (c)} \quad & F(A, B, C, D)' = [A' + B' + ACD]' \\ & = [A' + B' + CD]' = AB(C' + D') \end{aligned}$$

$$\begin{aligned} 2.26 \text{ (a)} \quad & F = [(A' + B)'B]'C + B = [A' + B + B']C + B \\ & = C + B \end{aligned}$$

$$2.26 \text{ (c)} \quad H = [W'X'(Y' + Z)']' = W + X + YZ$$

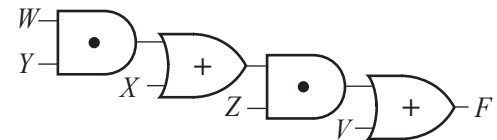
$$2.24 \text{ (b)} \quad (X + (Y'(Z + W))')' = X'Y'(Z + W)' = X'Y'Z'W'$$

$$\begin{aligned} 2.24 \text{ (d)} \quad & (A + B)CD + (A + B)' = CD + (A + B)' \\ & \quad \{ \text{By Elimination Theorem with } X = (A + B) \} \\ & = CD + A'B' \end{aligned}$$

$$\begin{aligned} 2.25 \text{ (b)} \quad & F(W, X, Y, Z)' = [X + YZ(W + X)]' \\ & = [X + X'YZ + WYZ]' \\ & = [X + YZ + WYZ]' = [X + YZ]' \\ & = X'Y' + X'Z' \end{aligned}$$

$$2.26 \text{ (b)} \quad G = [(AB)'(B + C)]'C = (AB + B'C')C = ABC$$

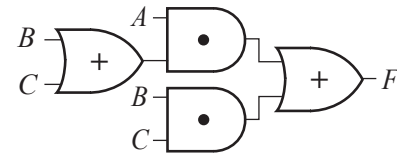
$$\begin{aligned} 2.27 \quad & F = (V + \underline{X} + W)(V + \underline{X} + Y)(V + Z) \\ & = (V + X + WY)(V + Z) = V + Z(X + WY) \\ & \quad \text{By Distributive Law with } X = V \end{aligned}$$



$$\begin{aligned} 2.28 \text{ (a)} \quad & F = ABC + A'BC + AB'C + ABC' \\ & = BC + AB'C + ABC' \text{ (By Uniting Theorem)} \\ & = C(B + AB') + ABC' = C(A + B) + ABC' \\ & \quad \text{(By Elimination Theorem)} \\ & = AC + BC + ABC' = AC + B(C + AC') \\ & = AC + B(A + C) = AC + AB + BC \end{aligned}$$

2.28 (b) Beginning with the answer to (a):

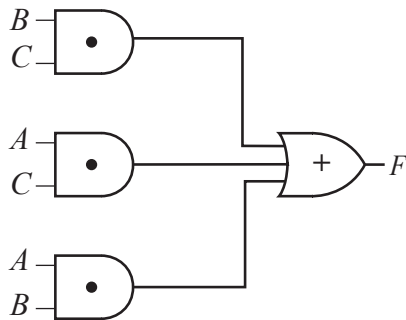
$$F = A(B + C) + BC$$



Alternate solutions:

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

$$F = AC + B(A + C)$$



2.29 (a)

XYZ	$X+Y$	$X'+Z$	$(X+Y)(X'+Z)$	XZ	$X'Y$	$XZ+X'Y$
000	0	1	0	0	0	0
001	0	1	0	0	0	0
010	1	1	1	0	1	1
011	1	1	1	0	1	1
100	1	0	0	0	0	0
101	1	1	1	1	0	1
110	1	0	0	0	0	0
111	1	1	1	1	0	1

2.29 (b)

XYZ	$X+Y$	$Y+Z$	$X'+Z$	$(X+Y)(Y+Z)(X'+Z)$	$(X+Y)(X'+Z)$
000	0	0	1	0	0
001	0	1	1	0	0
010	1	1	1	1	1
011	1	1	1	1	1
100	1	0	0	0	0
101	1	1	1	1	1
110	1	1	0	0	0
111	1	1	1	1	1

Unit 2 Solutions

2-29 (c)

XYZ	XY	YZ	$X'Z$	$XY+YZ+X'Z$	$XY+X'Z$
000	0	0	0	0	0
001	0	0	1	1	1
010	0	0	0	0	0
011	0	1	1	1	1
100	0	0	0	0	0
101	0	0	0	0	0
110	1	0	0	1	1
111	1	1	0	1	1

2.29 (d)

ABC	$A+C$	$AB+C'$	$(A+C)(AB+C')$	AB	AC'	$AB+AC'$
000	0	1	0	0	0	0
001	1	0	0	0	0	0
010	0	1	0	0	0	0
011	1	0	0	0	0	0
100	1	1	1	0	1	1
101	1	0	0	0	0	0
110	1	1	1	1	1	1
111	1	1	1	1	0	1

2.29 (e)

$WXYZ$	$W'XY$	WZ	$W'XY+WZ$	$W'+Z$	$W+XY$	$(W'+Z)(W+XY)$
0000	0	0	0	1	0	0
0001	0	0	0	1	0	0
0010	0	0	0	1	0	0
0011	0	0	0	1	0	0
0100	0	0	0	1	0	0
0101	0	0	0	1	0	0
0110	1	0	1	1	1	1
0111	1	0	1	1	1	1
1000	0	0	0	0	1	0
1001	0	1	1	1	1	1
1010	0	0	0	0	1	0
1011	0	1	1	1	1	1
1100	0	0	0	0	1	0
1101	0	1	1	1	1	1
1110	0	0	0	0	1	0
1111	0	1	1	1	1	1

2.30

$$\begin{aligned}
 F &= (X+Y')Z + X'YZ' \\
 &= (X+Y' + X'YZ')(Z+X'YZ') \\
 &= (X+Y'+X')(X+Y'+Y)(X+Y'+Z')(Z+X')(Z+Y)(Z+Z') \\
 &= (1+Y')(X+1)(X+Y'+Z')(Z+X')(Z+Y)(1) \\
 &= (1)(1)(X+Y'+Z')(Z+X')(Z+Y)(1) \\
 &= (X+Y'+Z')(Z+X')(Z+Y)
 \end{aligned}$$

(from the circuit)
 (Distributive Law)
 (Distributive Law)
 (Complementation Laws)
 (Operations with 0 and 1)
 (Operations with 0 and 1)

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

(from the circuit)

