

# Homework 3 Solutions for Computer Logic and Circuit Design: PHYS306/COSC330

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## 1 4-1: Boolean Operations and Expressions

- Exercise 5: (a) 11 (b) 101 (c) 00 (d) 101 (e) 110 (f) 10 (g) 100
- Exercise 6: (a) The expression reduces to  $X = AC + B$  (see Tab. 1). (b) The expression reduces to  $X = \bar{A}\bar{B}C$ , which is a S-SOP term. Thus, the only true state is 001. (c) The expression may be written  $X = \bar{A}\bar{B}C + \bar{A}BC + A\bar{B}C$ . This is an S-SOP expression with three true states (see Tab. 1). (d) The expression reduces to  $X = B$ , so  $X$  just follows  $B$ . (e) The expression reduces to  $X = \bar{A}\bar{B}C + \bar{A}BC + A\bar{B}C$ , which is an S-SOP expression with three true states (see Tab. 1).

A	B	C	X	A	B	C	X	A	B	C	X
0	0	0	0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	1	0	0	0	1	0
0	1	0	1	0	1	0	0	0	1	0	0
0	1	1	1	0	1	1	0	0	1	1	0
1	0	0	0	1	0	0	0	1	0	0	1
1	0	1	1	1	0	1	1	1	0	1	1
1	1	0	1	1	1	0	1	1	1	0	1
1	1	1	1	1	1	1	1	1	1	1	0

Table 1: Tables for Exercise 6. (left) Part (a) (middle) part (c) (right) part (e).

## 2 4-2: Laws and Rules of Boolean Algebra

- Exercise 7: (a) Commutativity of addition (b) commutativity of multiplication (c) distribution.

## 3 4-3: DeMorgan's Theorems

- Exercise 11: (a)  $X = (\bar{A} + \bar{B} + \bar{C})(\bar{E} + \bar{F} + \bar{G})(\bar{H} + \bar{I} + \bar{J})(\bar{K} + \bar{L} + \bar{M})$  (b)  $X = \bar{A}\bar{B}\bar{C} + BC$  (c)  $X = \bar{A}\bar{B}\bar{C}\bar{D}\bar{E}\bar{F}\bar{G}\bar{H}$

## 4 4-4: Boolean Analysis of Logic Circuits

- Exercise 13: (a)  $X = ABCD$  (b)  $X = AB + C$  (c)  $X = A + \bar{B}$  (d)  $X = AC + BC$
- Exercise 15: (a) An XOR gate (see Fig. 1). (b)  $X = AB + \bar{A}\bar{B} + \bar{A}BC$  (c)  $X = \bar{A}BC + \bar{A}B\bar{D}$  (d) The expression actually simplifies, but the solution manual provides the more *complex* version of the circuit.

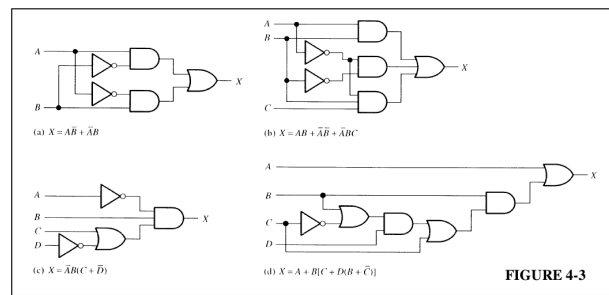


Figure 1: Answers to Exercise 15.

3. Exercise 16: See Fig. 2.

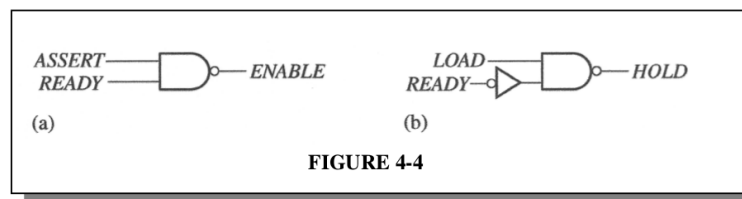


Figure 2: Answers to Exercise 16.

## 5 4-5: Logic Simplification Using Boolean Algebra

- Exercise 21: (a)  $X = BD + BE + \bar{D}F$  (b)  $X = \bar{A}\bar{B}C + \bar{A}\bar{B}D$  (c)  $X = B$  (d)  $X = AB + CD$  (e)  $X = ABC$ .
- Exercise 22: (a) Circuits B and D both reduce to  $A\bar{B} + AC\bar{D}$ .