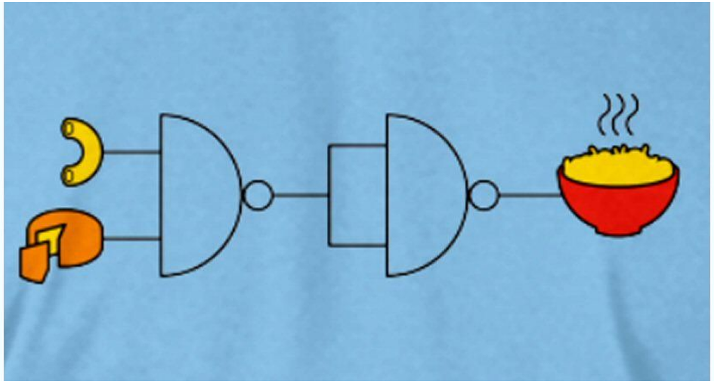
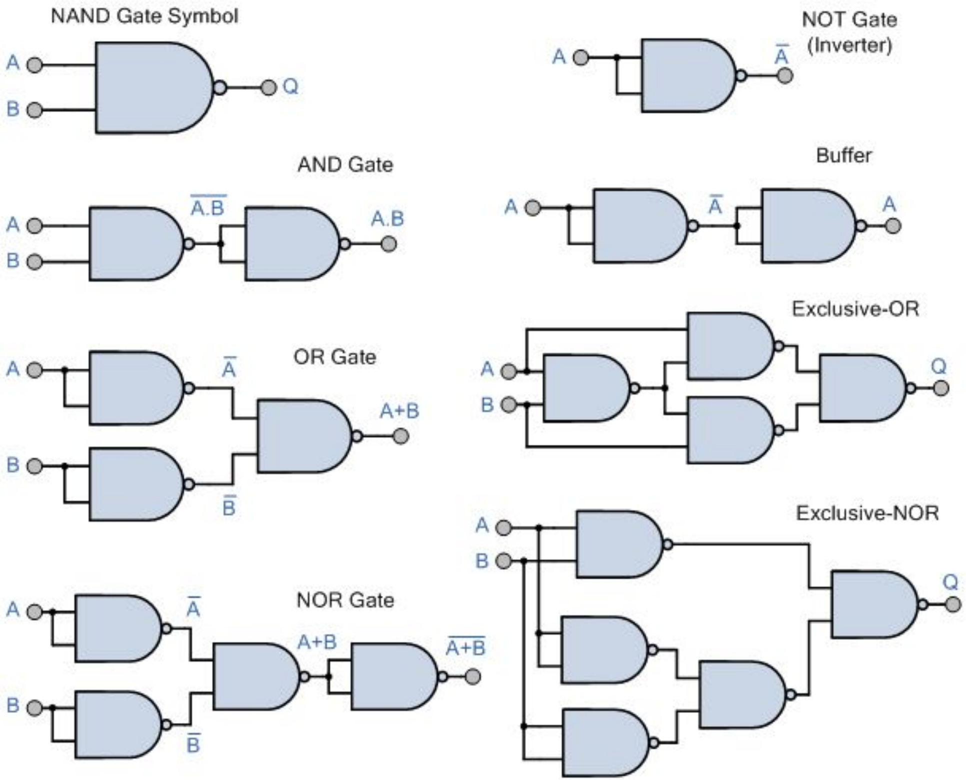


Combinational Logic Analysis

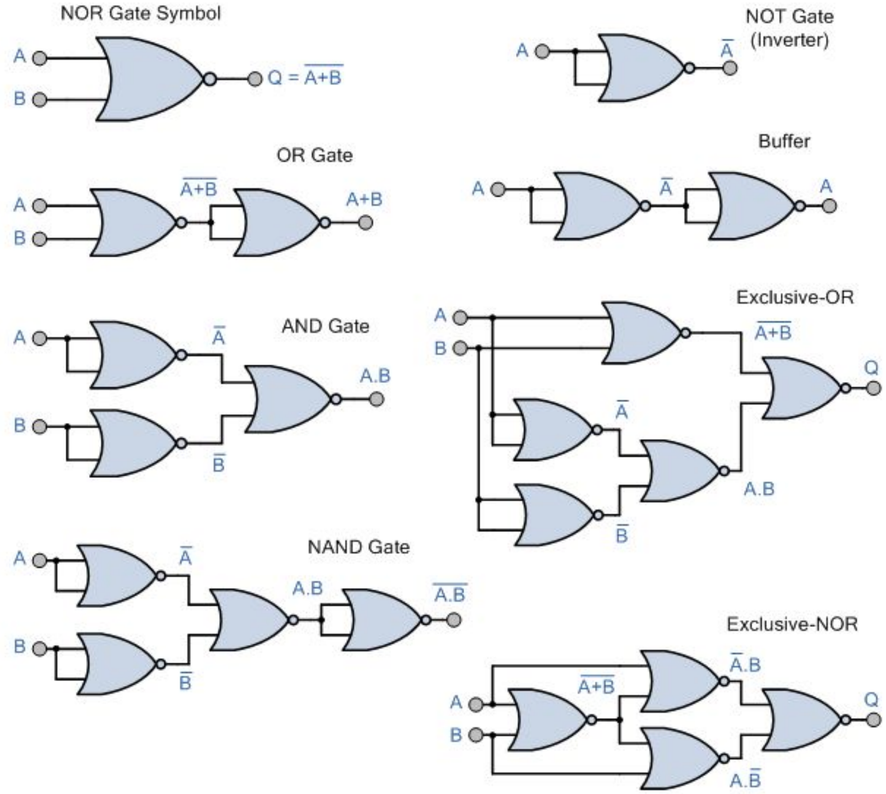
Chapter 5

Sumaiyah Zahid

NAND Gate As a Universal Gate

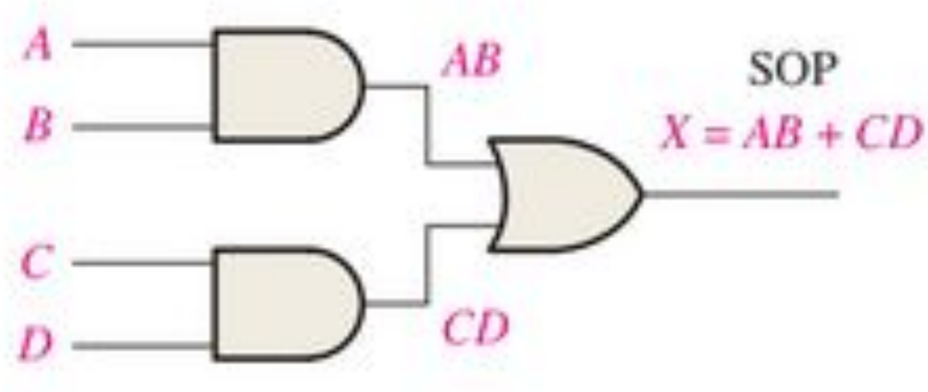


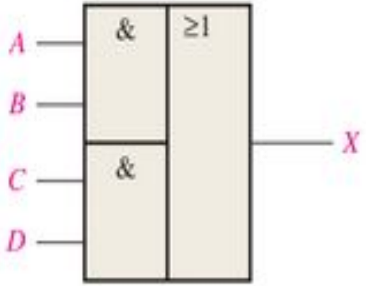
NOR Gate As a Universal Gate



AND OR Logic

An AND-OR circuit directly implements an SOP expression, assuming the complements (if any) of the variables are available.





(b) ANSI standard rectangular outline symbol

AND OR Logic

EXAMPLE 5–1

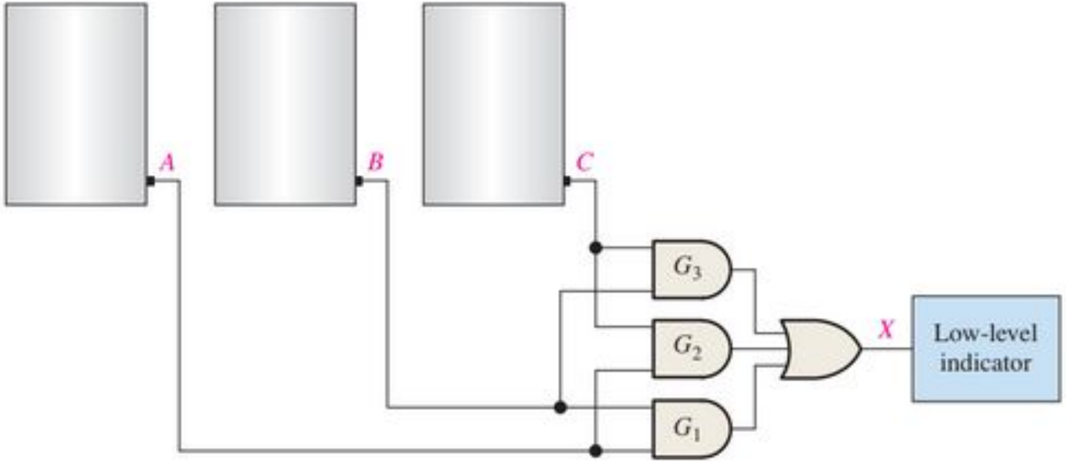
In a certain chemical-processing plant, a liquid chemical is used in a manufacturing process. The chemical is stored in three different tanks. A level sensor in each tank produces a HIGH voltage when the level of chemical in the tank drops below a specified point.

Design a circuit that monitors the chemical level in each tank and indicates when the level in any two of the tanks drops below the specified point.

EXAMPLE 5–1

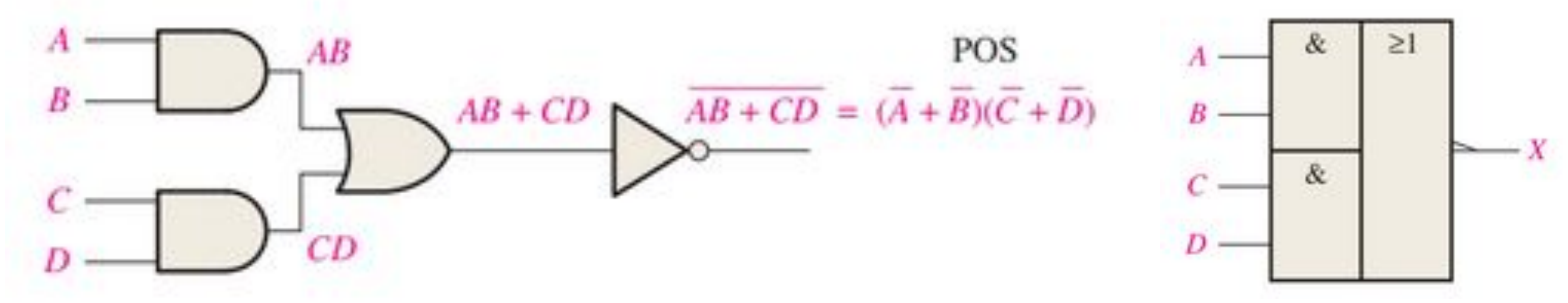
In a certain chemical-processing plant, a liquid chemical is used in a manufacturing process. The chemical is stored in three different tanks. A level sensor in each tank produces a HIGH voltage when the level of chemical in the tank drops below a specified point.

Design a circuit that monitors the chemical level in each tank and indicates when the level in any two of the tanks drops below the specified point.



AND OR INVERT Logic

POS expressions can be implemented with AND-OR-Invert logic.



AND OR INVERT Logic

EXAMPLE 5–2

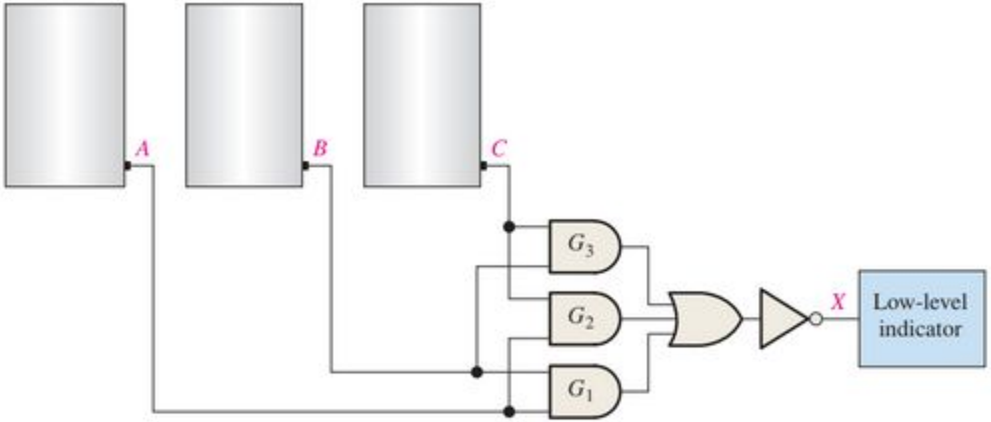
The sensors in the chemical tanks of Example 5–1 are being replaced by a new model that produces a LOW voltage instead of a HIGH voltage when the level of the chemical in the tank drops below a critical point.

Modify the circuit in Figure 5–2 to operate with the different input levels and still produce a HIGH output to activate the indicator when the level in any two of the tanks drops below the critical point. Show the logic diagram.

EXAMPLE 5–2

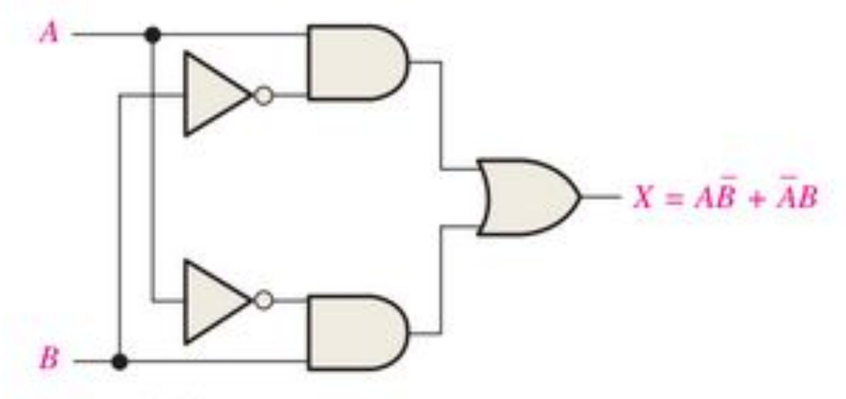
The sensors in the chemical tanks of Example 5–1 are being replaced by a new model that produces a LOW voltage instead of a HIGH voltage when the level of the chemical in the tank drops below a critical point.

Modify the circuit in Figure 5–2 to operate with the different input levels and still produce a HIGH output to activate the indicator when the level in any two of the tanks drops below the critical point. Show the logic diagram.



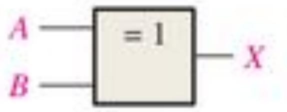
EXCLUSIVE-OR Logic

$$X = A \oplus B$$



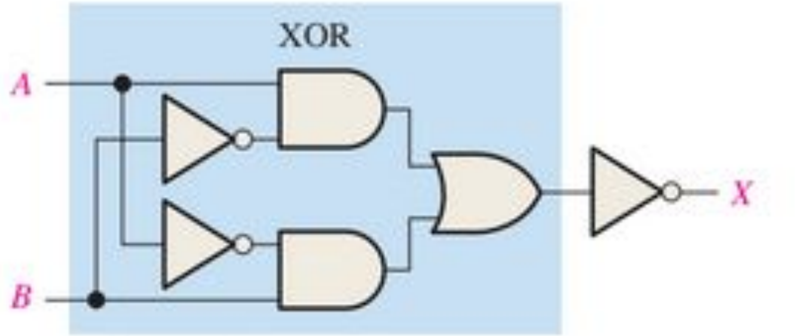
(a) Logic diagram

(b) ANSI distinctive shape symbol

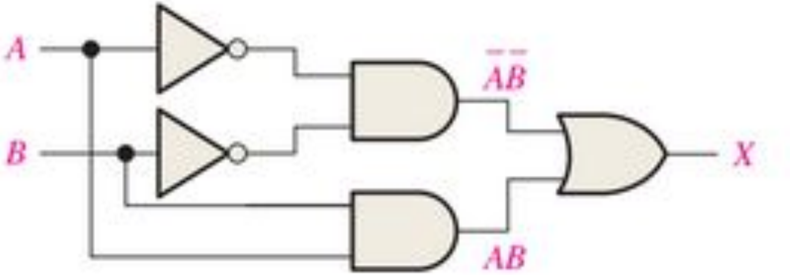


(c) ANSI rectangular outline symbol

EXCLUSIVE-NOR Logic



(a) $X = \overline{A\bar{B} + \bar{A}B}$



(b) $X = \bar{A}\bar{B} + AB$

EXCLUSIVE-OR Logic

EXAMPLE 5–3

Use exclusive-OR gates to implement an even-parity code generator for an original 4-bit code.

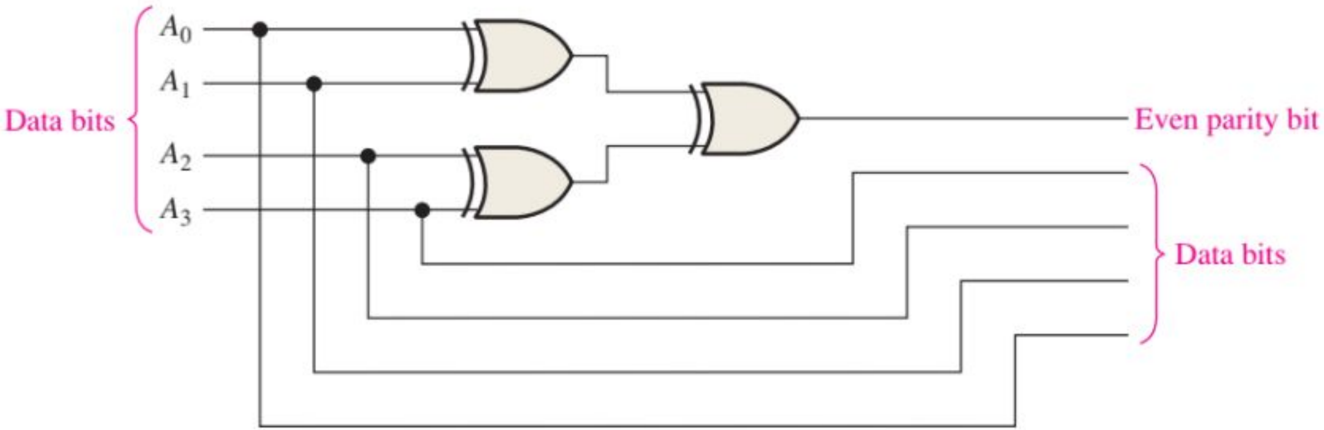


FIGURE 5–7 Even-parity generator.

EXCLUSIVE-OR Logic

EXAMPLE 5–4

Use exlusive-OR gates to implement an even-parity checker for the 5-bit code generated by the circuit in Example 5–3.

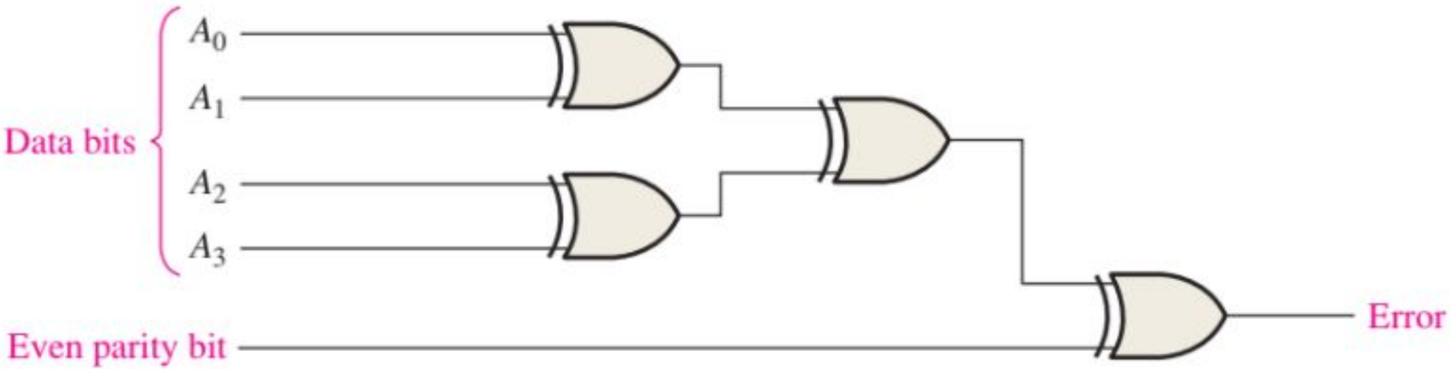


FIGURE 5–8 Even-parity checker.

Implementing Combinational Logic

EXAMPLE 5–6

Develop a logic circuit with four input variables that will only produce a 1 output when exactly three input variables are 1s.

Implementing Combinational Logic

EXAMPLE 5–7

Reduce the combinational logic circuit in Figure 5–14 to a minimum form.

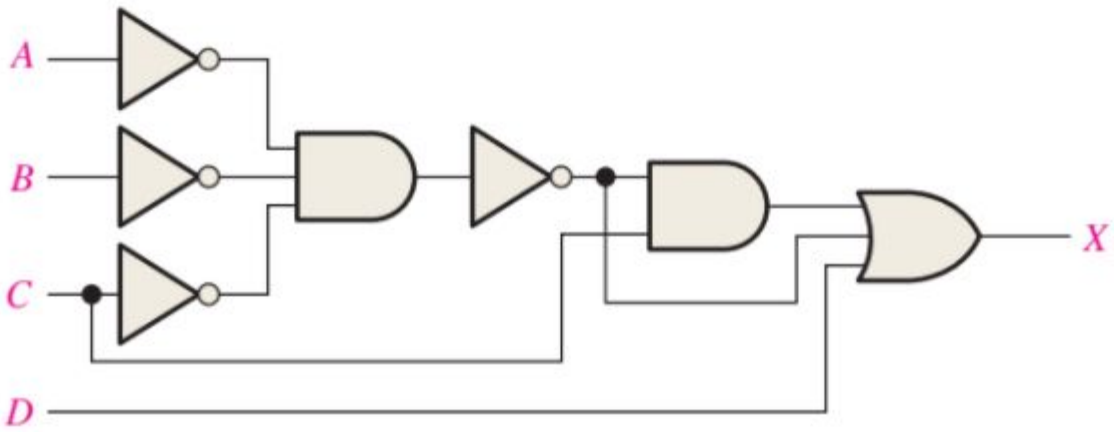


FIGURE 5–14
Open file F05-14 to
verify that this circu
equivalent to the ga
in Figure 5–15.
MultiSim

Implementing Combinational Logic

EXAMPLE 5–8

Minimize the combinational logic circuit in Figure 5–16. Inverters for the complemented variables are not shown.