4.4.2 Design of Full-subtractors

A combinational circuit of full-subtractor performs the operation of subtraction of three bits—the minuend, subtrahend, and borrow generated from the subtraction operation of previous significant digits and produces the outputs difference and borrow. Let us designate the input variables minuend as X, subtrahend as Y, and previous borrow as Z, and outputs difference as D and borrow as B. Eight different input combinations are possible for three input variables. The truth table is shown in Figure 4.10(*a*) according to its functions.

Input variables			*Outputs*	
X	*Y*	*Z*	*D*	*B*
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

Figure 4-10 (a)

	Y′Z′	Y′Z	YZ	YZ′
X′		1		1
X	1		1	

Figure 4.10(b) Map for function D.

	Y′Z′	Y′Z	YZ	YZ′
X′		1	1	1
X			1	

Figure 4.10(b) Map for function B.

Karnaugh maps are prepared to derive simplified Boolean expressions of D and B as in Figures 4.10(*b*) and 4.10(*c*), respectively.

The simplified Boolean expressions of the outputs are

D = X′Y′Z + X′YZ′ + XY′Z′ + XYZ and

B = X′Z + X′Y + YZ.

The logic diagram for the above functions is shown in Figure 4.11.

Similar to a full-adder circuit, it should be noticed that the configuration of the combinational circuit diagram for full-subtractor as shown in Figure 4.11 contains two-input and three-input AND gates, and three-input and four-input OR gates. Other