

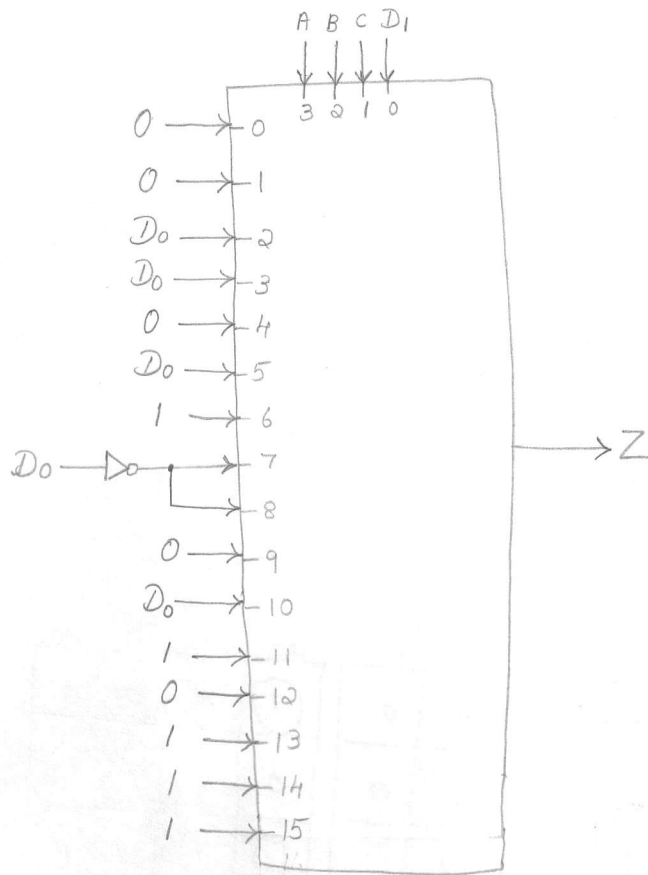
5.2 (a)

A	B	C	D ₁	D ₀	Z
0	0	0	0	0	0
0	0	0	0	1	0
0	0	0	1	0	0
0	0	0	1	1	0
0	0	1	0	0	0
0	0	1	0	1	1
0	0	1	1	0	0
0	0	1	1	1	1
0	1	0	0	0	0
0	1	0	0	1	0
0	1	0	1	0	0
0	1	0	1	1	1
0	1	1	0	0	1
0	1	1	0	1	1
0	1	1	1	0	1
0	1	1	1	1	0
1	0	0	0	0	1
1	0	0	0	1	0
1	0	0	1	0	0
1	0	0	1	1	0
1	0	1	0	0	0
1	0	1	0	1	1
1	0	1	1	0	1
1	0	1	1	1	1
1	1	0	0	0	0
1	1	0	0	1	0
1	1	0	1	0	1
1	1	0	1	1	1
1	1	1	0	0	1
1	1	1	0	1	1
1	1	1	1	0	1
1	1	1	1	1	1

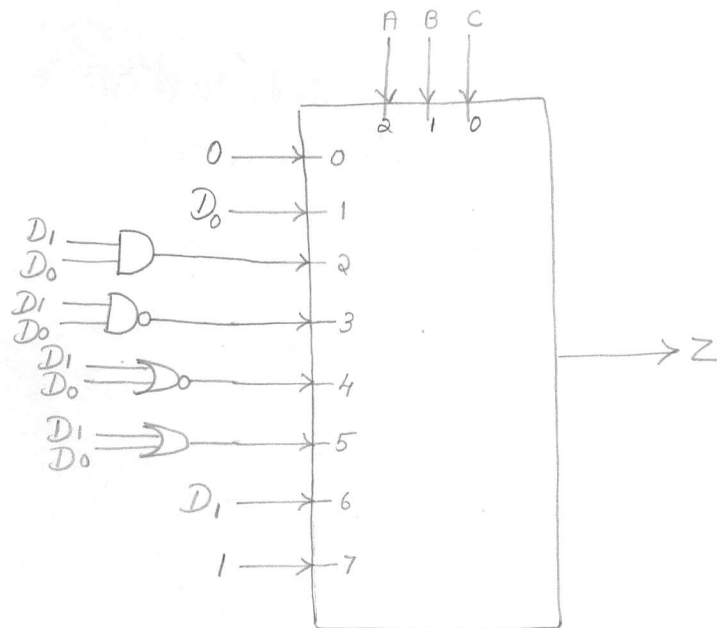
		D ₁ D ₀				D ₁ D ₀			
		00	01	11	10	00	01	11	10
BC	00	0	0	0	0	1	0	0	0
	01	0	1	1	0	0	1	1	1
	11	1	1	0	1	1	1	1	1
	10	0	0	1	0	0	0	1	1
		A=0				A=1			

$$Z = BCD_1' + B'CD_0 + BCD_0' + BC'D_1D_0 + ABD_1 + ACD_1 + AB'C'D_1D_0'$$

(b.)



(c.)



(d) The first implementation requires five 3-input gates, one 4-input gate and one 5-input gate, plus 4 inverters. In terms of cost, this is high, since it takes time to derive the implementation. The 16 to 1 mux requires only 1 gate, but takes up the max amount of area. The 8 to 1 mux requires four 2-input gates and takes up area as well. If cost is not a problem, the first would be best. If area is not a problem, the second would be best.

5.3.

(a.)

I_3	I_2	I_1	O_1	O_0
0	0	0	0	0
0	0	1	0	1
0	1	0	1	0
0	1	1	1	0
1	0	0	1	1
1	0	1	1	1
1	1	0	1	1
1	1	1	1	1

(2)

(b.) K-map for O_1

$I_3 \backslash I_2 I_1$	00	01	11	10
0	0	0	1	1
1	1	1	1	1

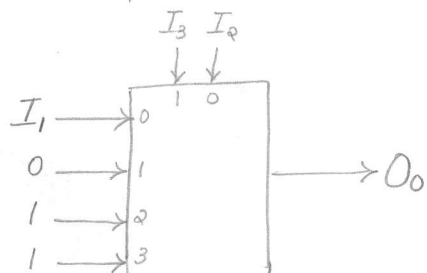
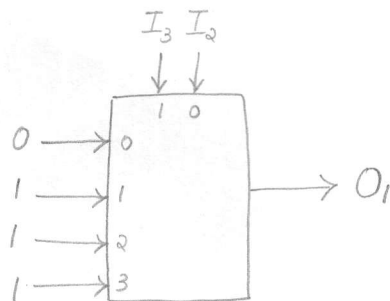
$$O_1 = I_3 + I_2$$

K-map for O_0

$I_3 \backslash I_2 I_1$	00	01	11	10
0	0	1	0	0
1	1	1	1	1

$$O_0 = I_3 + I_2' I_1$$

(c.)



(d) Part (b) needs two 2 i/p OR gates, one 2 i/p AND gate and one inverter.
 Part (c) needs two muxes, but no additional logic. It takes more area compared to (b).

If area is not a factor, (c) is better.

(b) requires more time to derive the implementation, but is better in terms of area. If cost is not a factor, (b) is better.

5.13) ALU Design

M	S_2	S_1	S_0	A_i	B_i	C_i	F_i	C_{i+1}
0	0	0	0	x	x	x	0	x
				0	0	x	0	x
				0	1	x	1	x
				1	0	x	1	x
				1	1	x	0	x
	0	1	0	0	0	x	1	x
				0	1	x	0	x
				1	0	x	0	x
				1	1	x	1	x
	0	1	1	0	0	x	0	x
				0	1	x	1	x
				1	0	x	1	x
				1	1	x	1	x
1	0	0	0	0	0	x	0	x
				0	1	x	0	x
				1	0	x	0	x
				1	1	x	1	x
1	0	0	1	0	0	x	1	x
				0	1	x	0	x
				1	0	x	0	x
				1	1	x	0	x

③

M	S_2	S_1	S_0	A_i	B_i	C_i	F_i	C_{i+1}
0	1	1	0	0	0	x	1	x
				0	1	x	1	x
				1	0	x	1	x
				1	1	x	0	x
	1	1	1	x	x	x	1	x
1	0	0	0	0	x	x	1	x
				1	x	x	0	x
	0	0	1	x	0	x	1	x
				x	1	x	0	x
	0	1	0	0	0	0	0	0
				0	1	0	1	1
				1	0	0	1	0
				1	1	0	0	0
				0	0	1	0	1
				0	1	1	1	0
				1	0	1	1	1
				1	1	1	0	1
	0	1	1	0	0	0	0	0
				0	1	0	1	0
				1	0	0	1	1
				1	1	0	0	0
				0	0	1	0	1
				0	1	1	1	1
				1	0	1	1	0
				1	1	1	0	1
	1	0	0	0	0	0	0	0
				0	1	0	1	0
				1	0	0	1	0
				1	1	0	0	1

M	$S_2 S_1 S_0$	$A_i B_i C_i$	F_i	C_{i+1}
1	1 0 1	0 x 1	1	0
		1 x 1	0	1
	1 1 0	x 0 x	0	x
		x 1 x	1	x
	1 1 1	0 x x	0	x
		1 x x	1	x

7 variable K-map is required for each of F_i & C_i .
 Even with Quine-McKluskey, this is quite time consuming.
 With straight forward implementation,

$$F_i = M' \left[S_2' S_1' S_0 A'B + S_2' S_1' S_0 AB' + S_2' S_1 S_0' A'B' + S_2' S_1 S_0' AB + S_2' S_1 S_0 (A+B) + S_2 S_1' S_0' AB + S_2 S_1' S_0 A'B' + S_2 S_1 S_0' (A'+B') + S_2 S_1 S_0 \right] +$$

$$M \left[S_2' S_1' S_0' A' + S_2' S_1' S_0 B' + S_2' S_1 S_0' (A'B + AB') + S_2' S_1 S_0 (A'B + AB') + S_2 S_1' S_0' (A'B + AB') + S_2 S_1' S_0 A' + S_2 S_1 S_0' B + S_2 S_1 S_0 A \right]$$

$$= M' \left[S_2' S_1' S_0 A'B + S_2' S_1' S_0 AB' + S_2' S_1 S_0' A'B' + S_2' S_1 S_0' AB + S_2' S_1 S_0 (A+B) + S_2 S_1' S_0' AB + S_2 S_1' S_0 A'B' + S_2 S_1 S_0' (A'+B') + S_2 S_1 S_0 \right] +$$

[Handwritten signature]

02/01/2005

HW - Appendix A

A.11) Sign & Magnitude

(a) $-13 = 101101$

(b) $-27 = 111011$

(c) $-5 = 100101$

A.12) One's Complement

(a) $-13 = 110010$

(b) $-27 = 100100$

(c) $-5 = 111010$

A.13) Two's Complement

(a) $-13 = 110011$

(b) $-27 = 100101$

(c) $-5 = 111011$

A.14) Addition with Two's Complement

$$\begin{array}{r} \text{(a)} \quad 15 + 1 = 001111 + \\ \quad \quad \quad 000001 \\ \hline \quad \quad \quad 010000 \quad (16) \end{array}$$

$$\begin{array}{r} \text{(b)} \quad -1 + 0 = 111111 + \\ \quad \quad \quad 000000 \\ \hline \quad \quad \quad 111111 \quad (-1) \end{array}$$

$$\begin{array}{r} \text{(c)} \quad -5 + -23 = 111011 + \\ \quad \quad \quad 101001 \\ \hline \quad \quad \quad 100100 \quad (-28) \end{array}$$

$$\begin{array}{r} 23 = 010111 \\ -23 = 101000 + \\ \hline \quad \quad 101001 \end{array}$$

$$\begin{array}{r} 28 = 011100 \\ -28 = 100011 + \\ \quad \quad \quad 1 \\ \hline \quad \quad 100100 \end{array}$$

$$\begin{array}{r} 011011 + \\ \hline 011100 \end{array}$$

$$(d) \quad -16 + 15 = \begin{array}{r} 110000 + \\ 001111 \\ \hline 111111 \end{array} (-1)$$

$$\begin{array}{r} 16 = 010000 \\ -16 = 101111 + \\ \hline 110000 \end{array}$$

$$(e) \quad -14 + (-2) = \begin{array}{r} 110010 + \\ 111110 \\ \hline 110000 \end{array} (-16)$$

$$\begin{array}{r} 14 = 001110 \\ -14 = 110001 + \\ \hline 110010 \end{array}$$

$$\begin{array}{r} 001111 + \\ \hline 010000 \end{array}$$

$$(f) \quad -27 + 12 = \begin{array}{r} 100101 + \\ 001100 \\ \hline 110001 \end{array} (-15)$$

$$\begin{array}{r} 27 = 000010 \\ -27 = 111101 + \\ \hline 111110 \end{array}$$

$$\begin{array}{r} 27 = 011011 \\ -27 = 100100 + \\ \hline 100101 \end{array}$$

$$\begin{array}{r} 001110 + \\ \hline 001111 \end{array} (-15)$$