ECE 465, Fall 2009
Homework 3

1. Prob. 3.63 using the alternate to Rule 6 followed by the sweep-up phase. **80**

Solution:

$$f_\alpha(A,B,C,D,E) = \sum m(0,4,6,20,22) + d(2,10,18)$$
$$f_\beta(A,B,C,D,E) = \sum m(4,6,11,19,20,27) + d(18,22)$$

Min-term	List 1 ABCDE	Flags	
0	00000	α	√
2	00010	α	√
4	00100	$\alpha\beta$	√
6	00110	$\alpha\beta$	√
10	01010	α	√
18	10010	$\alpha\beta$	√
20	10100	$\alpha\beta$	√
11	01011	β	√
19	10011	β	√
22	10110	$\alpha\beta$	√
27	11011	β	√

Min-terms	List 2 ABCDE	Flags	
0,2	000-0	α	√
0,4	00-00	α	√
2,6	00-10	α	√
2,10	0-010	α	PI_4
2,18	-0010	α	√
4,6	001-0	$\alpha\beta$	√
4,20	-0100	$\alpha\beta$	√
6,22	-0110	$\alpha\beta$	√
18,19	1001-	β	PI_5
18,22	10-10	$\alpha\beta$	PI_6
20,22	101-0	$\alpha\beta$	√
11,27	-1011	β	PI_7
19,27	1-011	β	PI_8

Min-terms	List 3 ABCDE	Flags	
0,2,4,6	00--0	α	PI_1
2,6,18,22	-0-10	α	PI_2
4,6,20,22	-01-0	$\alpha\beta$	PI_3

		f_α					f_β					
		√ 0	√ 4	√ 6	√ 20	√ 22	√ 4	√ 6	√ 11	19	√ 20	√ 27
$\bullet PI_1$	α	⊗	×	×								
PI_2	α			×		×						
$\bullet PI_3$	$\alpha\beta$		×	×	⊗	×	⊗	⊗			⊗	
PI_4	α											
PI_5	β									×		
PI_6	$\alpha\beta$					X						
$\bullet PI_7$	β								⊗			×
PI_8	β									×		×

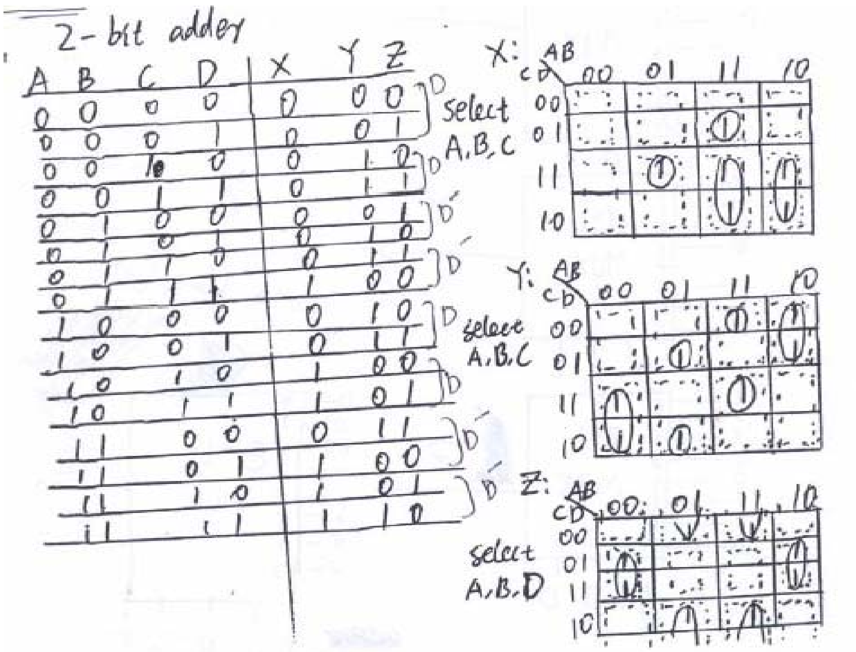
Essential prime implicants: PI_1 and PI_3 for function f_α; PI_3 and PI_7 for f_β.
All minterms of f_α are covered. Choose PI_5 or PI_8 to cover minterm 19 of f_β

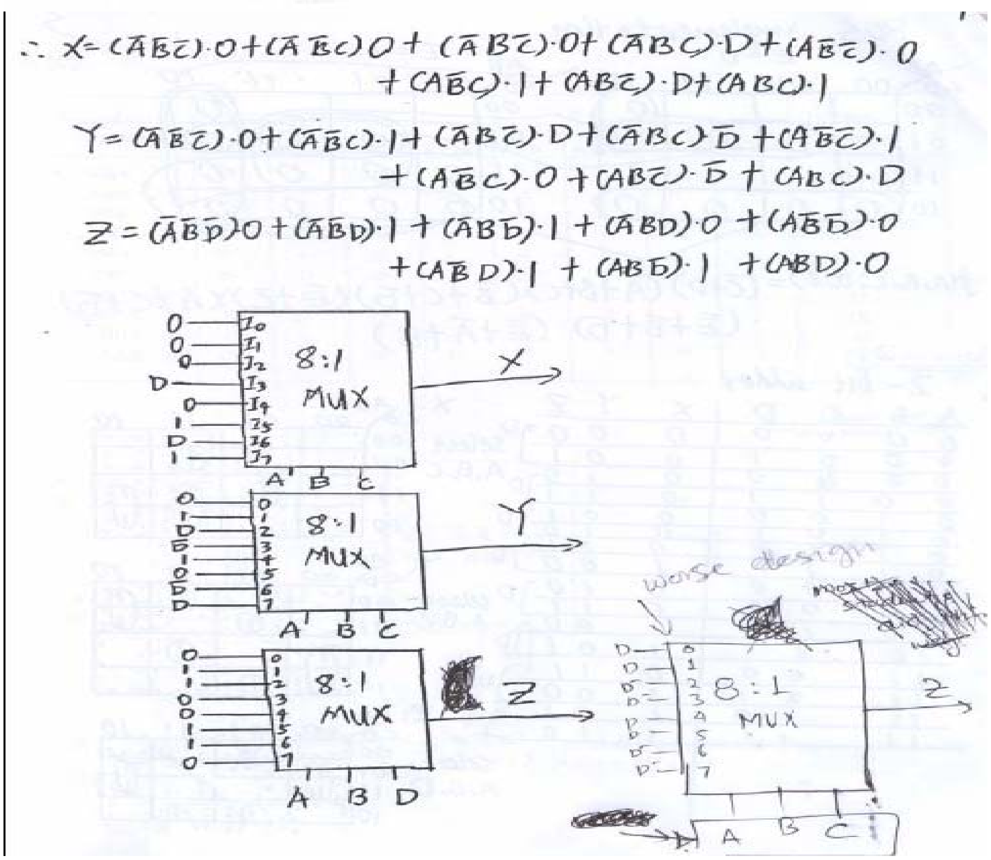
$$f_\alpha = PI_1 + PI_3 = \bar{A}\bar{B}\bar{E} + \bar{B}C\bar{E}$$
$$f_\beta = PI_3 + PI_7 + PI_5 = \bar{B}C\bar{E} + B\bar{C}DE + A\bar{B}\bar{C}D$$
or
$$f_\beta = PI_3 + PI_7 + PI_8 = \bar{B}C\bar{E} + B\bar{C}DE + A\bar{C}DE$$

The above is the solution obtained before the sweep-up phase. The EPIs and pseudo-EPIs are:
PI_1 and PI_3 in f_α (these are all f_α's PIs) and PI_3 and PI_7 in f_β. Deleting the MTs covered By PI_3 and PI_7 in f_β, we get MT 19 remaining which need to be covered by PI_5 or PI_8. Both have the same cost, so either choice is OK, and the solution remain unchanged after sweep-up.

4. Implement a 2-bit adder function (i.e., a 2-bit binary number a_1a_0 added to another 2-bit binary number b_1b_0 to yield a 3-bit sum $s_2s_1s_0$) using three 8:1 MUXes. Derive the TT and show all steps clearly for deriving the (data) inputs to the MUXes. **40**

Solution:





5. Implement the function $f(A,B,C,D) = \sum m(2,4,5,8,10,12,13,14)$ using a 4:1 MUX and a choice of 2 control variables such that a minimal number of 2-i/p AND/OR gates are used. Assume that the inverted inputs of all variables are available for free. **50**

Solution: