EE345: Introd. to MicroControllers   Exam # 1   Prof. Ahmad Abu-El-Haija   2nd Nov. 2010

Student Name: Student Number:

82

Note: All questions have equal marks. You must show all your work to get credit.

Problem 1

25

(i) Determine the base b in each of the following cases:

(a) $(361)_{10} = (551)_b$

$1\times b^0 + 5\times b^1 + 5b^2 = 361$

$5b^2 + 5b - 360 = 0$

$b^2 + b - 72 = 0 \Rightarrow (b+9)(b-8) = 0 \Rightarrow \boxed{b=8}$

(b) $(859)_{10} = (5B7)_b$

$7\times b^0 + 11\times b^1 + 5\times b^2 = 859$

$5b^2 + 11b - 852 = 0$

$(b-12)(5b+71) = 0 \Rightarrow \boxed{b=12}$

(ii) The following arithmetic operations are correct for one particular number system. Determine the radix for the given operations.

(a) 23 + 44 + 14 + 32 = 223

$2b+3+4b+4+b+4+3b+2 = 2b^2+2b+3$

$10b+13 = 2b^2+2b+3 \Rightarrow \boxed{\text{radix} = 5}$

$2b^2 - 8b - 10 = 0 \Rightarrow b^2 - 4b - 5 = 0 \Rightarrow (b-5)(b+1) = 0$

$b = 5$

(b) SQRT (51) = 6

$\sqrt{5r+1} = 6$

$5r+1 = 36$

$5r = 35 \Rightarrow r = 7 \Rightarrow \boxed{\text{radix} = 7}$

Problem 2

25

(i) Using the theorems of Boolean algebra simplify the following expression:

f (A, B, C, D) = B + BCD + B'CD + AB + A'B + B'C

$= B + AB + B + A'B + B + BCD + B'CD + B'C$

$= B(1+A) + B(1+A') + B(1+CD) + B'C(D+1)$

$= B + \cancel{B} + \cancel{B} + B'C$

$= B + B'C = \underbrace{(B+B')}_{1}(B+C) = \boxed{B+C}$

(ii) Construct a truth table for the following function and from the truth table obtain an expression for the inverse (i.e., complement) function. Give your answer as a sum of products.

f (A, B, C) = A C + B C + A B

$f'(A,B,C) = A'B'C' + A'B'C + A'BC' + AB'C'$

$= A'C' + B'C' + A'B'$

A	B	C	f
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	1
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	1

25

Problem 3

(i) Expand the following Boolean function into its canonical form:

$f = B + C D + A B D' + A' B' C D'$

$f = (A+A')(B)(C+C')(D+D') + AB(C+C')D' + (A+A')(B+B')CD + A'B'CD'$

$= ABCD + ABCD' + ABC'D + ABC'D' + A'BCD + A'BCD' + A'BC'D + A'BC'D'$
$+ ABCD' + ABC'D' + ABCD + AB'CD + A'BCD + A'B'CD + A'B'CD'$

$= ABCD + ABCD' + ABC'D + ABC'D' + A'BCD + A'BCD' + A'BC'D + A'BC'D'$
$+ AB'CD + A'B'CD + A'B'CD'$

$= \sum m(2,3,4,5,6,7,11,12,13,14,15)$

(ii) Express the three-variable function $f = \Sigma\,(0, 1)$ as a product of maxterms.

$f(a,b,c) = \Pi(2,3,4,5,6,7)$

$f = (a+b'+c)(a+b'+c')(a'+b+c)(a'+b+c')(a'+b'+c)(a'+b'+c')$

Problem 4

7

Suppose we want to implement a circuit that has three inputs and two outputs, where:

$f_1(A, B, C) = \Sigma\,(0, 1, 5)$ $f_2(A, B, C) = \Sigma\,(3, 5, 7)$

Implement this circuit using the minimum number of gates. Assume that inputs are available in normal and complemented forms.

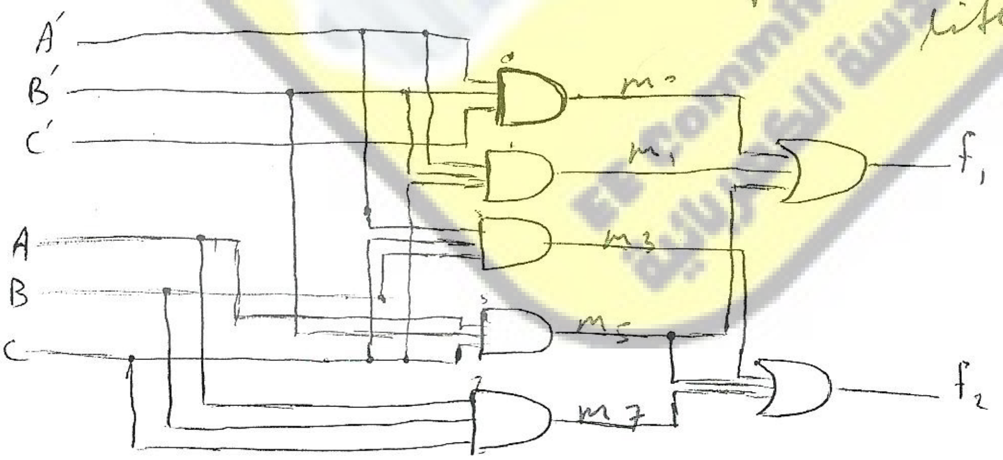
Hint: Circuit may be implemented using five gates.

$f_1 = A'B'C' + A'B'C + AB'C$

$f_2 = A'BC + AB'C + ABC$

why didn't you simplify??

too many gates & literals.



-8

2 extra gates

10 = literals -10

-18