

EE 2720, Spring 2011

Homework # 4

Due Wednesday April 6, 2011 in class

EE 2720  
Homework #4

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Problem 1: Design a circuit to convert a number represented in Excess-3 code to BCD. You must use Karnaugh maps in this problem. Provide a circuit diagram as well.

Problem 2: Design a combinational logic circuit with three inputs  $A, B, C$  and three outputs  $X, Y, Z$ . When the binary inputs are 0, 1, 2 or 3, the binary output is two greater than the binary input. When the binary input is 4, 5, 6, or 7, the binary output is 2 less than the input. You must use Karnaugh maps in this problem.

Problem 3: A full adder (FA) is a circuit that adds three binary digits  $X, Y, C_{in}$ , producing a sum and a carry,  $S$  and  $C_{out}$ . The sum  $S$  is 1 if one or three of  $X, Y, C_{in}$  are 1. The carry  $C_{out}$  is 1, if two out of three, or all three of  $X, Y, C_{in}$  are 1. Design a full adder circuit using AND, OR and NOT gates; (I want an AND-OR realization). Show all your work, truth table, Karnaugh maps, logic equations and logic diagrams. (Here you learned something new that I was going to do in class!!)

Problem 4: A half adder (HA) is a circuit that adds two binary digits  $X, Y$ , producing a sum and a carry  $S$  and  $C_{out}$ . The sum  $S$  is 1 if one of  $X$  or  $Y$  are 1. The carry  $C_{out}$  is 1 if both  $X$  and  $Y$  are 1. Design a half adder circuit using AND, OR and NOT gates; (I want an AND-OR realization). Show all your work, truth table, Karnaugh maps,

Problem 4 cont: logic equations and logic diagrams.  
(again here you learned something new that I was going to do in class!!)

~~Problem 5: ... don't do this. ...~~

Problem 6: Using a Karnaugh map, derive a simplified sum-of-products expression for the logic function  $F = \sum_{w,x,y,z}(1,2,4,7,8,11,13,14)$ .

Problem 7: Using Karnaugh maps, find a simplified sum-of-products expression for each of the following logic functions:

- (a)  $F = \sum_{x,y,z}(1,3,5,6,7)$
- (b)  $F = \sum_{w,x,y,z}(1,4,5,6,7,9,14,15)$
- (c)  $F = \prod_{w,x,y}(0,1,3,4,5)$
- (d)  $F = \sum_{w,x,y,z}(0,2,5,7,8,10,13,15)$
- (e)  $F = \prod_{A,B,C,D}(1,7,9,13,15)$ .

Problem 8: Using Karnaugh maps, find a simplified product-of-sums expression for each logic function of problem 7 above. Combine 0's here.

Problem 9: Using Karnaugh maps, find a simplified sum-of-products expression for each of the following logic functions:

HW # 4 cont.Problem 9 cont:

- (a)  $F = \sum_{w,x,y,z} (0, 1, 3, 5, 14) + d(8, 15)$   
 (b)  $F = \sum_{w,x,y,z} (0, 1, 2, 8, 11) + d(3, 9, 15)$   
 (c)  $F = \sum_{A,B,C,D} (1, 5, 9, 14, 15) + d(11)$   
 (d)  $F = \sum_{A,B,C,D} (1, 5, 6, 7, 9, 13) + d(4, 15)$

Problem 10: Using Karnaugh maps, find a simplified product-of-sums expression for each logic function of problem 9 above.

Problem 11: Derive a simplified product-of-sums expression for the prime BCD-digit detector described in handout # 16. In this problem, you must, of course provide a Karnaugh map.

Note: Enjoy this homework. It is lots of fun!! It is about Karnaugh maps mainly, which is the most important subject in EE 2720. So enjoy it!!

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Alex!!