Cairo University

Institute of Statistical Studies and Research
Department of Computer and Information Sciences
Digital Logic –CS504
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Time permitted: Three Hours

Question 1.

Knowing that, the data are manipulated in a computer that stores two decimal digits, find the solution of the following ***in binary***, then convert the result into ***decimal value***.

a) *00110110 – 11000110* 2's complement comment on the result
b) *10110011 + 00101011* comment on the result
c) The ***Excess-3 BCD*** of the decimal digits *59*. 10001100
d) The ***signed binary number*** for the decimal number *-59*. 11111011
e) The ***2's complement*** of the decimal number *-62* 11000110

Question 2.

Find all the minimum expressions in both ***Sum of Products and Product of Sums forms*** for the following:

a) **F(a,b,c,d)= Σm(3,4,9,13,14,15) +Σd(2,5,10,12),** ***using k-map*** AB + AC̄d + BC + ĀB̄
b) **H(w,x,y,z)= wx+ w'xz+ xyz+ w x y'+ w'xz'+ w'y,** ***using Algebraic rules*** x + xyz + w̄

Question 3:

Assume all input are available both uncomplemented and complemented, draw the Implementation of the logical function:

$$G(a,b,c,d) = a'b'd' + bde' + bc'd + a'ce$$

a) In a two-level schematic using *Nand* gates of any size,
b) In a two-level schematic using *NOR* gates of any size,
c) Using tow-input *NAND* gates (none of which may be used as a NOT)

Question 4:

Design a ***synchronous counter*** that go through the sequence ***13, 7, 8, 2, 15, 9, 14*** ; using *T* flip flop.

a) Find the flip flops input equations
b) Show the state diagram for the counter indicating what happens if the system, initially, is in one of the **unused states**.

Question 5 :

A counter with two *D FFs*, *A* and *B* and control line *x*. If $x = 0$, it counts *0, 3, 1* and repeat; if $x = 1$, it counts *1, 2, 3* and saturate (i.e., 1 2 3 3 3…).

a) Assume that *x* changes only when it is in state *1* or *3*, calculate the Flip Flop inputs
b) Implement the counter using *AND*, *OR* and *NOT* gates.
c) Show if it is a self started system, illustrate your answer with the state diagram.

Question 6:

Design, minimize and implement a combinational circuit that converts from the ***BCD 2421*** code to the **2-of-5** code. The following is the truth table for them. (Consider the do not cares!!)

2421 Code	2 of 5 Code	2421 Code	2 of 5 Code
0000	11000	1011	01010
0001	10100	1100	01001
0010	10010	1101	00110
0011	10001	1110	00101
0100	01100	1111	00011

Question 7:

Design the solution for sequential system specified by the following state table and state assignment using a ***D*** flip flop for q_1 and ***JK*** flip flop for q_2.

a) Find the flip flop input equations
b) Find system output equation
c) Show a block diagram of the system using ***AND***, ***OR*** and ***NOT*** gates.

State Table

q	q^+ $x=0$	q^+ $x=1$	z
A	*C*	*B*	*1*
B	*C*	*A*	*1*
C	*A*	*C*	*0*

State Assignment

q	q_1	q_2
A	*1*	*1*
B	*0*	*1*
C	*1*	*0*

Best of Luck ☺