Cairo University	Cairo University – Institute of Statistical Studies and Researches			
	Department: Computer Sciences			
	Academic Year:2015/2016	Semester: Two		
	Date: May 31st	Level: Diploma		
Course Title: Digital Logic and Computer Organization	Course code: CS504	Time: 3 Hours	Exam marks: 75	# Exam. Sheets: 3
Exam. Instructions : Calculators and Cell Phones are not permitted				

Question #1 *(15 points)*

a. Convert the decimal number **437** to
   1. Binary
   2. Octal
   3. Hexadecimal

b. Show the decimal equivalent of the following numbers if they are interpreted as:
   i. 100110000101 *ii. 001001110011*
   1. Unsigned
   2. Signed (2's complement)
   3. BCD (5421)

c. Show a truth table for a system with four input a,b,c and d and one output F. The first two inputs a, b represent a 2-bit binary number in the range (0-3), the last two inputs (c,d) represent another 2-bit binary number in the same range. The output F is to be 1 if and only if the sum of the two numbers is odd.

Question #2 *(15 points)*

Given the following logical expressions:

1. $F = a'b'c + a'bc + ab'c + ab'c'$
2. $G = wx'y'z + wxy'z + w'xy'z + wxyz' + wx'y'z'$

a) Reduce each of the expressions to a sum of product expression
b) Reduce each of the expressions to product of sum expression
c) Check your answer using k-Map
d) Manipulate the following to a minimum ***sum of product*** expression:

$$H(w,x,y,z)=(w+x'+z)(w'+y+z')(x+y+z)$$

Question #3 *(15 points)*

Design and build a digital system to convert decimal digits to gray codes. Use the table:

Decimal	Gray	Decimal	Gray
0	0000	8	1100
1	0001	9	1101
2	0011	10	1111
3	0010	11	1110
4	0110	12	1010
5	0111	13	1011
6	0101	14	1001
7	0100	15	1000

a) Show the truth table for the converter
b) Use the truth table to find the expressions for each of the four output
c) Minimize each of the four outputs
d) Implement the system using two level schematic

Question (4) ([illegible] points)

A. Consider the following functions:

$F1(A,B,C,D)=\sum m($[illegible]$)$

$F2(A,B,C,D)=\sum m($[illegible]$)$

$F3(A,B,C,D)=\sum m($[illegible]$)$

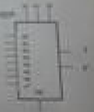
1- Implement them using PAL with four inputs and three outputs. [illegible]

2- Implement them using 3×8 decoder, with active low outputs [illegible]

[illegible table]

B. Given 8-to-1 line Multiplexer as the one shown in the right, with an active low enable input and with an active high and active low output. Implement the following function in POS form:

$F(a,b,c,d)=\prod M(1,2,3,6,7)$



Solve ONLY ONE of the following questions:

Question (5) ([illegible] points)

A. Given the following state table:

1- Find the input equations for the sequential circuit, using a D-FF for A, and JK-FF for B

2- Find the system output equation (for Z)

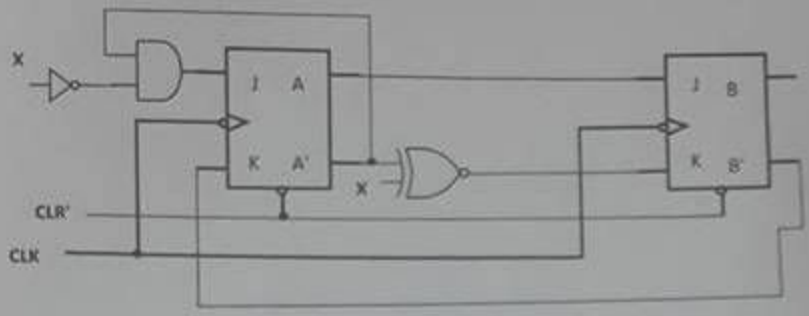
3- Implement the design

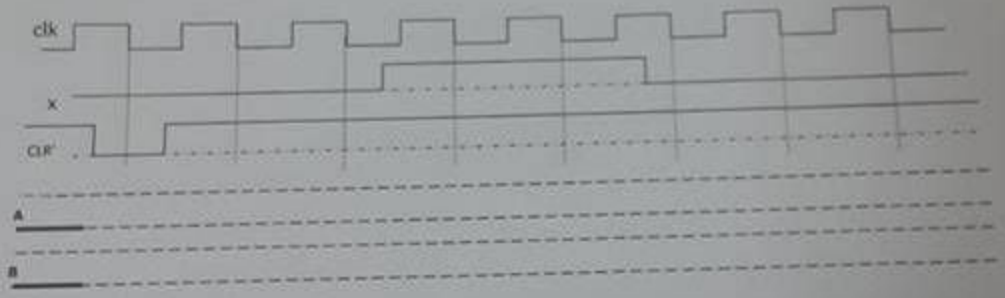
A	B	A^+B^+ x=0	A^+B^+ x=1	Z
0	0	1 1	0 0	1
0	1	0 0	1 1	0
1	0	0 1	0 1	1
1	1	1 0	0 1	1

B. Design a synchronous counter that goes through the sequence [illegible] and repeat using T Flip Flops. Show the state diagram indicating what happens if it initially is in one of the unused states (show state table. NOTE: consider the input for each FF) and draw the state diagram.

Question #6 (15 points)

A. Given the following circuit:





1. Build the state table
2. Complete the timing diagram for the values of the A and B, (A and B are initially zero).

B. **Design and show block diagram** for a synchronous counter that goes through the sequence *0, 2, 5, 3, 4, 7, 6* and repeat, using *T Flip Flops*. (Show state table, MSTT, calculate the input for each FF, and draw the block diagram for the counter)

☺ Best of Luck ☺