Institute Of Statistical Studies and Research
Department of Computer and Information Sciences
Digital Logic_CS504
June 2010
Time permitted: Three Hours

Solve the following problems in the provided spaces: ***Clarify*** *your answers.* ***Label*** *your signal lines in each and every* ***Design and Table.***

Question 1: (12 points)

a) Using the version of Hamming code shown, Code the data "*0111*"

a1= a3 ⊕ a5 ⊕ a7
a2= a3 ⊕ a6 ⊖ a7
a4= a5 ⊕ a6 ⊕ a7

The Hamming code(0111) =

b) If the word "*1001110*", was received after being coded with Hamming code, what word was sent (assuming single error).

Original word =

c) The following 8-bit numbers were found in a computer. What is the decimal value represented, if the number is stored as: (show your solution)
(i) BCD Exsess3 (ii) two's complement number (iii) BCD 5421
(v) Binary Signed integer (iv) Binary Unsigned integer

1) 10110100 2) 10010011 3) 00101000

Solve here:

	BCD Exsess3	Two's C	BCD 5421	Signed	Unsigned
10110100					
10010011					
00101000					

Question 2: (12 points)

(A)

The months of the year are coded in four variables, a, b, c and d, such that January is 1000, February is 0010, ..., and December is 1100. February of a leap year (in which, February is 29 days) is coded as 0000. Remember: April, June, September and November has 30 days, all other months except February has 31 days)

a) Show the Truth Table with five variables v, w, x, y, z , that indicates the number of days in the selected month.
b) Write the switching formula for each of v, w, x, y and z.
c) Minimize v, w, x, y and z, applying switching rules.

Solve here: (a)

a	B	c	d	v	w	x	y	z
0	0	0	0					

Solve here: (b): Write the switching formulae for each of v, w, x, y and z

v=

w=

x=

y=

z=

Solve here: (c): _Minimize each function

v=

w=

x=

y=

z=

(B) Use switching Algebra rules to reduce the following expression to a minimum Sum of products and a minimum Product of sums, **show** each step.

G= wx+ x'y +wyz +wxz' + wyz'

Question 3: (6 points)

Given the function, (assume all variables are available, both complemented and uncomplemented)

$$F = a'b' + a'c + a\,b'$$

a) Show a block diagram for a two level implementation of *F* using *And* and *OR* gates

b) Show a block diagram for an implementation of *F* using, Only, NAND gates

c) Expand *F* to sum of minterms, eliminate any duplications.

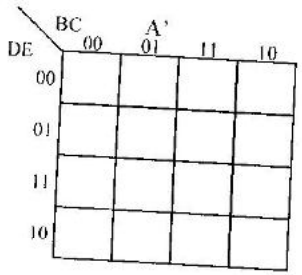
Question 4: (8 points)

Find the minimum Sum of products, and the minimum Product of sums for the following functions ((that is, using K-map, circle the terms on the map and write the algebraic expressions):

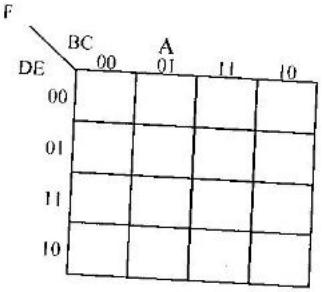
a) F(A,B,C,D,E) = ΣM(0,1,5,6,7,8,9,14,17,20,21,22,23,25,28,29,30)
b) G(WX,Y,Z)= Σm(4, 6, 11, 12, 13) + Σd(3, 5, 7, 9, 10, 15)

Solution (a)

F



F

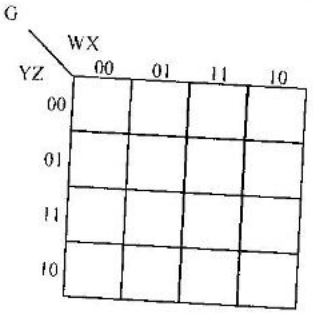


F=

Solution (b):

G(WX,Y,Z)= Σm(4, 6, 11, 12, 13) + Σd(3, 5, 7, 9, 10, 15)

G



G=

Question 5: (12 points)

It is required to build a converter that convert from ***BCD2-of-5*** code to ***BCD5421***.(the two codes are shown bellow)

Decimal	BCD 5421	BCD 2-of-5
0	0000	11000
1	0001	10100
2	0010	10010
3	0011	10001
4	0100	01100
5	1000	01010
6	1001	01001
7	1010	00110
8	1011	00101
9	1100	00011

All other combinations of input bits never occur

a) Build the truth table for the *BCD 2-of-5* (five functions v,w,x,y,z) from the *BCD 5421* (four inputs a,b,c,d)
b) Use k-map to minimize each of the five functions v, w, x, y, z.
c) Implement the converter using Programmable Array Logic (PAL) with 12 *AND* gates and five 4-input *OR* gates, show the terms and its sums.

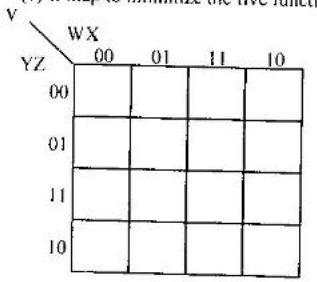
Solve here

(a) Truth table

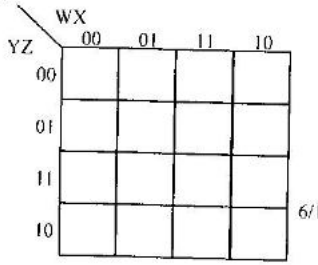
a	B	c	d	v	w	x	y	z

(b) k-map to minimize the five functions v, w, x, y, z.

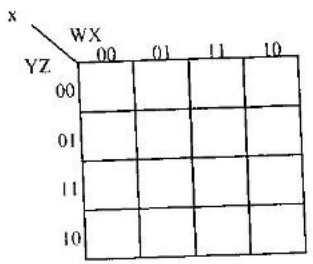
v



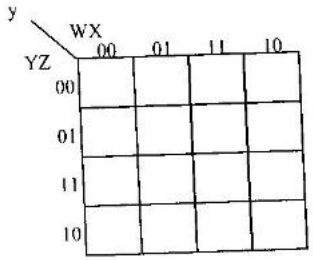
W



v=

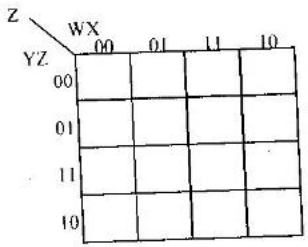


w=



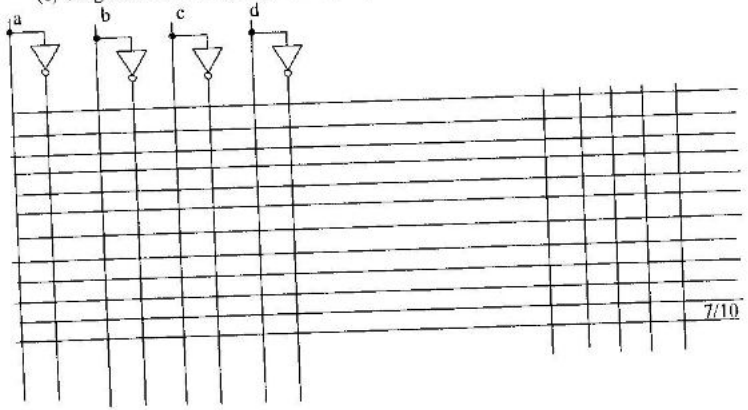
x=

y=



z=

(c) Programmable Array Logic (PAL) implementation



Question 6: (10 points)

A system has one input ($x \in \{a,b\}$) and one output ($z \in \{0, 1\}$). The output z is one iff the input (x) had been the same for three consecutive clock cycles, otherwise, z is zero. Assume $x = a$ as an initial state.

a- Describe the system, including its initial state
b- State the system Model
c- Show the transition and the output functions in a state table
d- Draw the state diagram

Solve here

a) Describe the system

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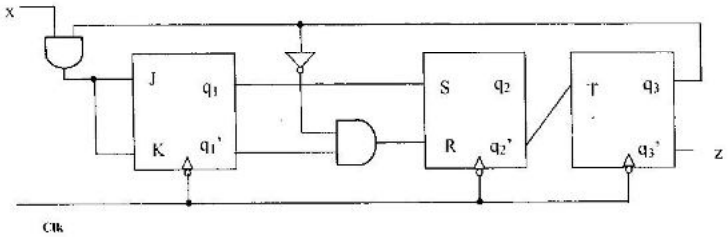
b) System Model is

c) State Table

d) State Diagram

Question 7: (10 points)
Given the following circuit:



a) State the design model
b) Build the state table
c) Assuming the initial state for q_1, q_2, q_3 to be *(000)* complete the given timing diagram for the circuit.

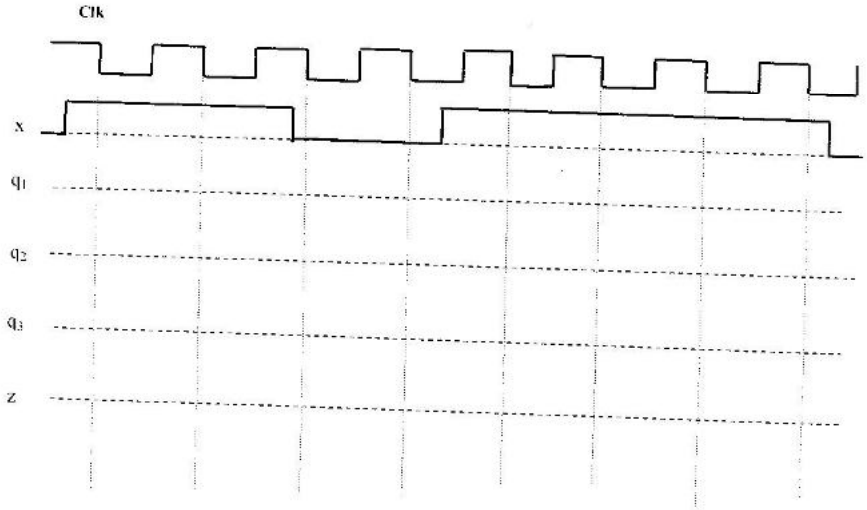
Solve Here

a) Design model is

c) State Table

Q1	Q2	Q3		

c) Timing diagram for the circuit:



☺ *Best Of LUCK* ☺