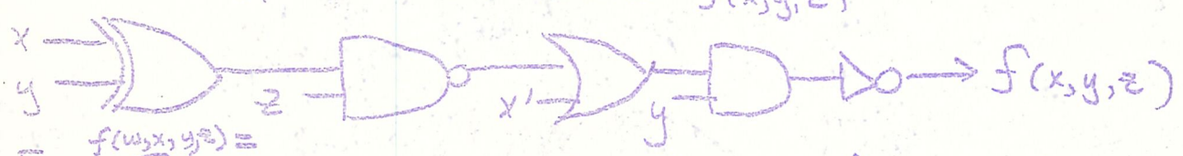
Digital Practice Test (PT1)

1. Two 8-bit registers have $(8C)_{16}$ and $(F9)_{16}$ resp. has contents What is the out come in hexidecimal if they are "XOR"ed?
2. Define "single error detecting codes" and state what is meant by a minimal product of sums form of a switching function
3. Simplify the boolean alg exps $x+y'+(x+y'+z')'$ & $xy+(x+z)'+yz'$
4. Show in any boolean alg $a \le b$ & $b \le c \Rightarrow a \le c$ [$a \le b \Leftrightarrow a \cdot b = a$]
5. Proof that {NAND} is functionally complete
6. Draw a map for the function $f(x,y,z)$



7. For $f(w,x,y,z) = \Sigma(0,2,4,5,6,8,10,12)$ find all the prime implicants which are essential? Give a minimal sum of products form for f. Is it unique?
8. Prove or disprove $xy+x'y+x'z+yz = xy+xy'+x'z+yz$
9. $f(w,x,y,z) = \Sigma(0,2,4,9,12,15) + \Sigma_{\phi}(1,5,7,10)$
   AB give a min. sum of prod.
   CD give a min. prod of sum
   E1 is the ans in AB unique? {Y/N}
   E2 is the ans in CD unique? {Y/N}
   E3 which is minimal {Neither, AB, CD, or both}
10. Show that $f(x,y,z) = (x'+y)z'$ is functionally complete
11. Show for any boolean alg. $x \oplus (y \oplus z) = (x \oplus y) \oplus z$ and $x \oplus (x \oplus y) = y$
12. Prove by induction for $n \ge 2$ (in Any boolean alg)

$$\underbrace{x \oplus x \oplus \ldots \oplus x}_{n\text{-}x\text{'s}} = \begin{cases} 0 & \text{if } n \text{ is even} \\ x & \text{if } n \text{ is odd} \end{cases}$$

13. Give a minimal two level AND-OR realization of the function in #6 above
14. Explain why the following yields a min prod of sums form for f
    1. Map f
    2. Complement the map
    3. Find min sum of prod form for the new map
    4. Complement ans in 3
15. Will the code 0110, 1001, 1111, 1100, 0011 detect single errors? why or why not?
16. For any boolean alg define $A \triangleright B = B + A'$ prove or disprove $A \triangleright B = B \triangleright A$.

TP 7 DUE 7 NOV 83 digital

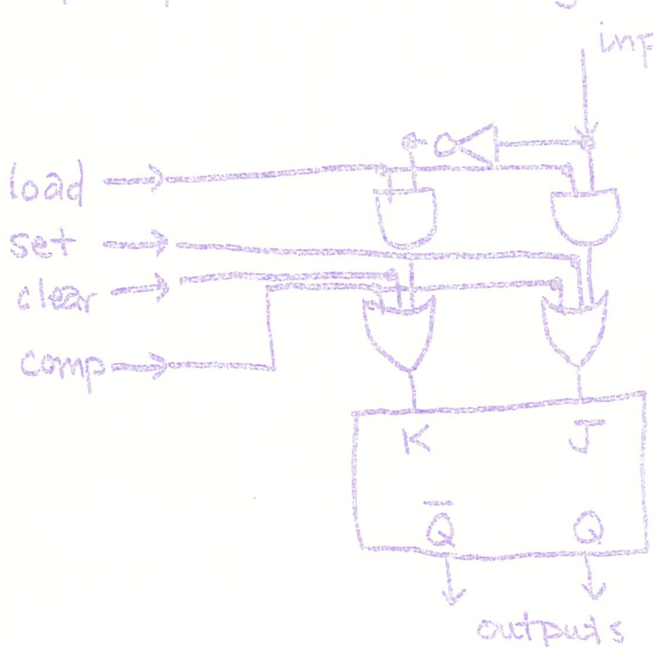
1.- bit register R.

R has two outputs ($Q, \bar{Q}$), one input (for Load) and four control lines (CLEAR, SET, LOAD, COMPLEMENT).

R satisfies the following table

input	control inputs clear	set	load	compl.	current state	next state
y	0	0	0	0	Q	Q
y	1	0	0	0	Q	0
y	0	1	0	0	Q	1
y	0	0	1	0	Q	y
y	0	0	0	1	Q	$\bar{Q}$
y	← all others →				Q	? (doesn't matter)

For example R could be realized using a JK flip flop via the following circuit



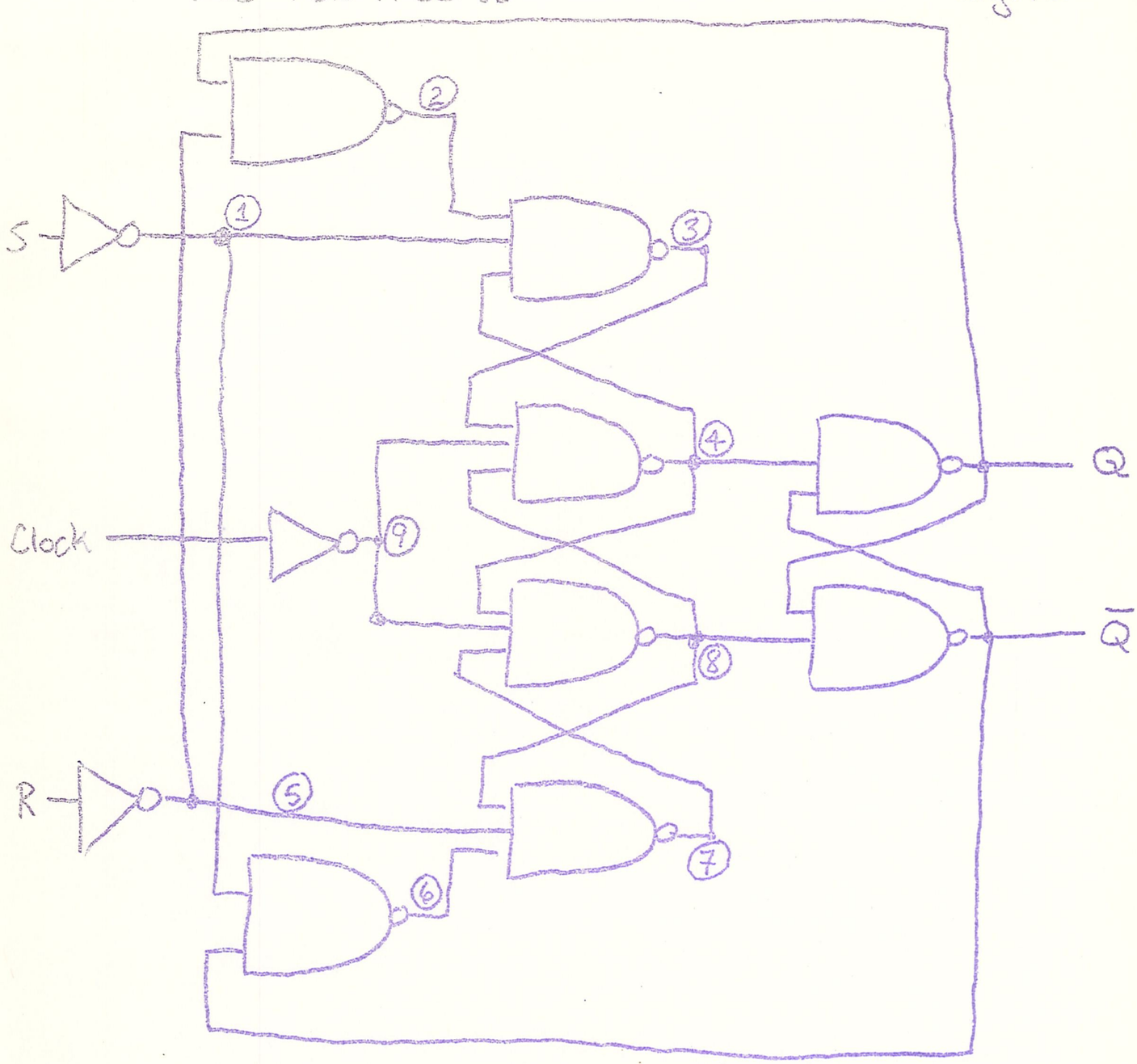
R.

YOUR PROBLEM: WITHOUT puting any gates on the clock line NOR using preclear or preset, realize the 1-bit register R

A. with a D flip flop

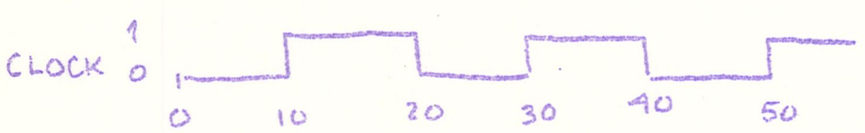
B. with a T flip flop

TP 6 due MON 17 OCT 83 digital



ALL GATES HAVE DELAY OF ONE ns

initially R = S = CLOCK = Q = ⑥ = ⑧ = ③
① = ⑤ = ⑨ = $\bar{Q}$ = ② = ⑦ = ④



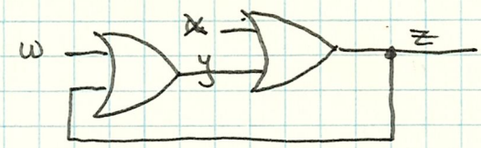
DO TIMING DIAGRAMS FOR BOTH CHOICES OF INPUT S

A.

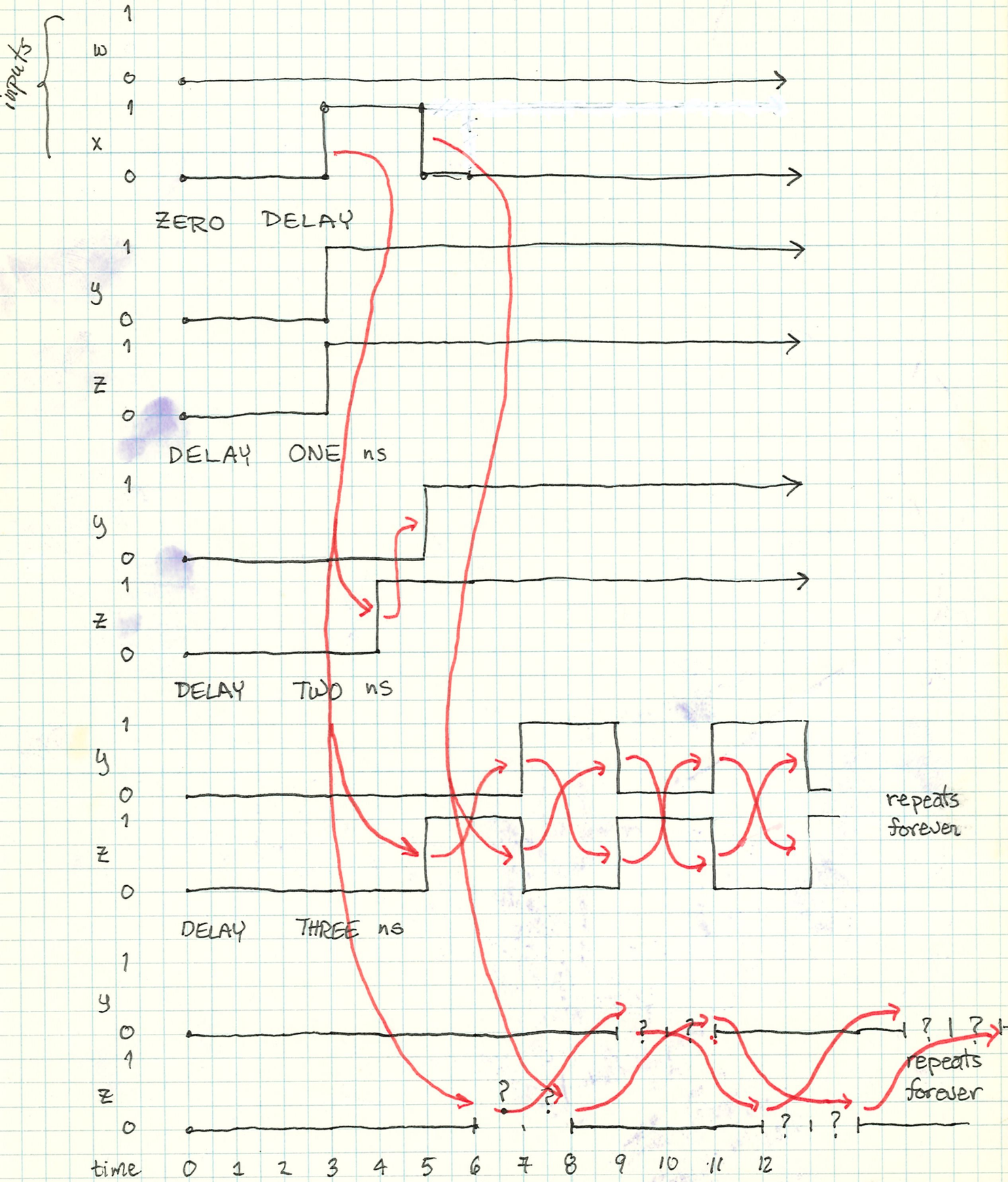
B

TP4

4.1 digital



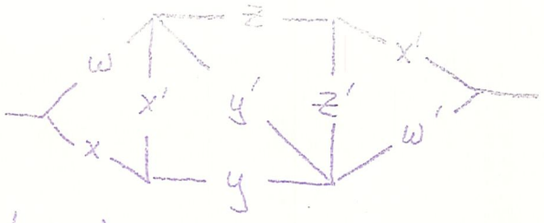
time 0 1 2 3 4 5 6 7 8 9 10 11 12 (in Nano Secs



time 0 1 2 3 4 5 6 7 8 9 10 11 12

FT2 — digital

1 A. Find all the tie sets & cutsets for the contact network to right.



B. Give a map of the function

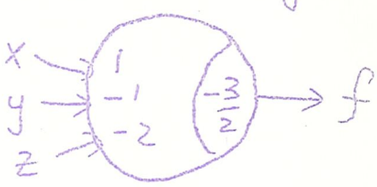
C. Find an equivalent series parallel network

2. Assuming there is at most one error in the hamming code 1110010

A. Circle the bit in error or say there is none B. decode the message.

C. Encode "5" in hamming code

3A Give a map for the threshold unit to right



B Use our technique for map entered variables on the map to right.

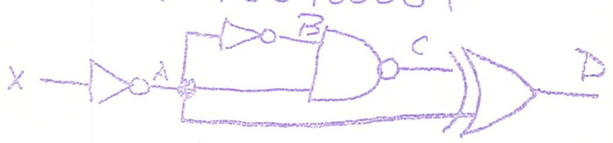
4. A. Use 3 2x4 decoders with enable to make a 3x8 decoder with enable

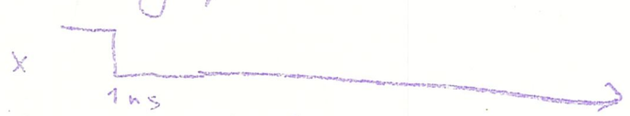
B. Use a 3x8 decoder and an or gate to realize $f(x,y,z) = x \oplus y \oplus z$

C. Do the same for part (B) with a 8x1 multiplex unit

5. Give a state diagram which will reconize the sequence 010 (overlaps OK) ie if input x = 1000101001011010
then output is z = 0000010100100001

6. do a time diagram for all gates have a delay of 1 ns.





A = 0 B = C = D = 1 initially

7. Realize the state table using a JK flip flop

	x=0	x=1
0	0/1	1/0
1	1/1	0/1

8. List the needed excitations

change required	J	K	S	R	T	D
0 to 0						
0 to 1						
1 to 0						
1 to 1						

9, for prime implicant chart

A. Which implicants are essential?

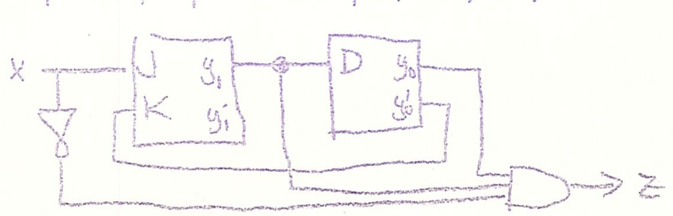
B. Which implicants are in every minimal express

C. which implicants are in no minimal express.

	a	b	c	d	e	f	g	h	i	j
A	x		x		x					
B			x							x
C								x	x	x
D	x	x								
E				x	x					
F						x		x		
G							x		x	

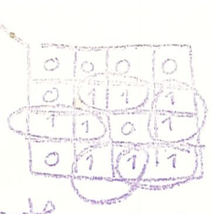
10. Realize f = x+y using only nand gates, using only nor gates.

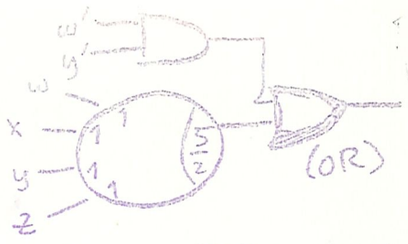
11, Give a state table for the circuit to right



13 DIGITAL

1. Find all static hazards in the map & in the circuit

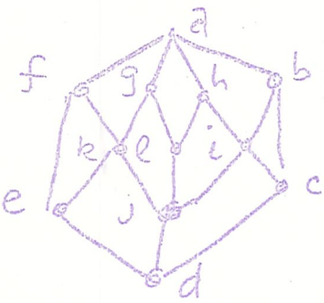




2. Carefully step by step construct the equivalence partition and a reduced state table in standard form for →

	x=0	x=1
A	A/0	D/1
B	B/0	C/1
C	D/1	A/0
D	E/1	B/0
E	F/0	G/0
F	A/0	H/0
G	A/0	D/1
H	B/0	C/1

3. A. Find All the Complements of e in the Hasse diagram



B. If x = 101010, y = 100111 then glb of x & y is _____ and lub of x & y is _____ (register order)

4. For each of the relations on $\mathbb{N} = \{0, 1, 2, 3, \ldots\}$ and properties below either say yes or say no and give a counterexample if not

xRy iff $|x-y| \leq 3$; xSy iff $x \leq y+3$

A. is it reflexive B is it symmetric C is it anti-symmetric
D. is it transitive E is it irreflexive

5. Use full (half) adders and a decoder to realize $S_{0,4,6}(x_1, x_2, x_3, \ldots, x_7)$

6. Write $AS'_{1,2,3}(B,C,D,E) + A'S_{2,3,4}(B',C',D',E')$ as a symmetric function of A, B, C, D, E using the "S" notation

7. A. Design a set-dominate unit using a RS flip-flop

B. Use a set-dominate unit to realize a JK flip-flop

C. Design a unit using an RS flip-flop such that the 11 input is a hold otherwise it is the same as a TRS-flip flop

S_d	R	current	next
0	0	Q	Q
0	1	Q	0
1	0	Q	1
1	1	Q	1

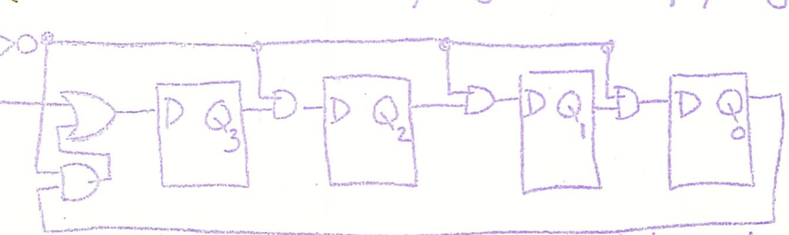
8. The function $f(v,w,x,y,z) = \Sigma(8,10,13,24,28) + \Sigma\phi(4,16,17,27,31)$ has a decomposition of the form $F(w,z,\Phi(v,x,y))$ Find it.

9. A. Design $S_{0,1,2}(w,x,y,z)$ using a contact network with a minimum of contacts

B. Realize this same function using one threshold unit

10. Use contact networks with minimum of spring to realize $T(w,x,y,z) = \Sigma(6,9,11,14,15)$ [12 springs] Partial credit for circuits with more springs — if # of springs stated.

11. the circuit to right is a ring counter. initially Start = 1. what is the next state?



After the first clock pulse Start = 0, list the states which follow in their order. Use two flip flops and a decoder to produce the same output sequence as $Q_3Q_2Q_1Q_0$ (i.e. draw the circuit)

12. List all possible reduced state tables in standard form with 2 or less states where the output is always 0 when current state is A and always 1 when the current state is B

13. Design a 4-bit register with controls c_0c_1 s.t. when $c_0=c_1=0$ it holds, when $c_0=1$ $c_1=0$ it counts up & when $c_0=0$ $c_1=1$ it counts by two's.

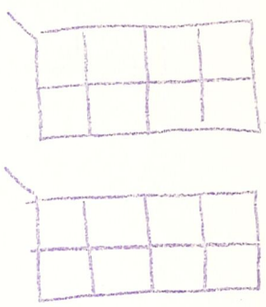
Digital TEST 2 by _____ SS no. _____

Show Full Work for Credit 1-4 : 10 pts ea 5-8 15 pts ea.

1. A. "OR" the two 8-bit registers containing $(A3)_{16}$ and $(47)_{16}$ and express the outcome in hexidecamal

B. Define a single error dectection code:

2. Prove or disprove: $x'z + yz + x'y = x'z + yz + xz$ (ANY Boolean Alg)

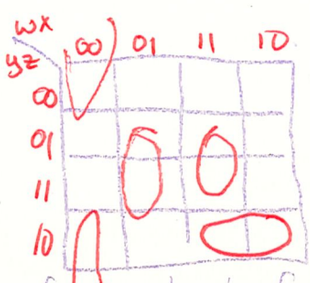


3. Prove for any boolean algebra $xy + [(x'z)'(w'+y'+z')]' = xy + x'z$

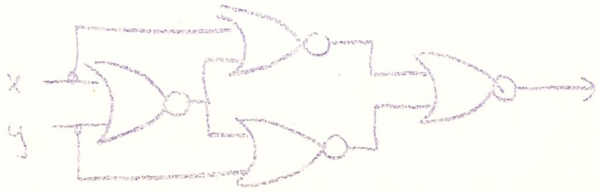
4. Show $f(x,y,z) = (x+y')z'$ is functionally complete

5. A $f(w,x,y,z) = w'xy' + x'yz' + y'z$ realize f as a two level circuit using only AND or OR gates. (primed variables avail.)

B. Draw a map for f in part A.



C. Write the output of the circuit below in a sum of products form

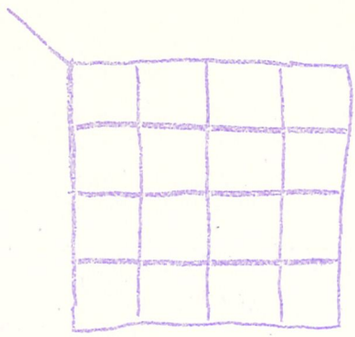


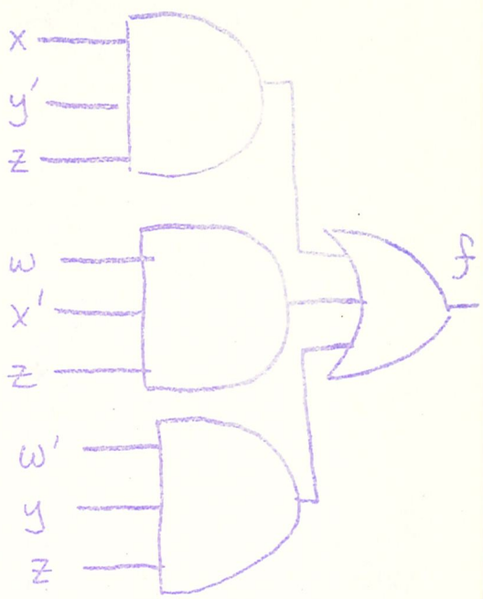
Digital test three by _____ 30

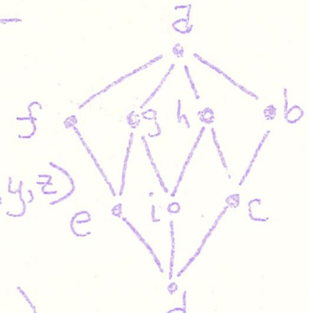
Show all work for Credit 1-4 10 pts each 5-8 15 pts each

1. A. Indicate All static hazards in the circuit to the right in the map beside it.

B. List All complements to e in the Hasse diagram to the right







2. The function $f(v,w,x,y,z) = \sum(1,15,20,21,27) + \sum_{\phi}(4,10,11,19,26)$ has a decomposition of the form $F(w,y,\underline{\phi}(v,x,z))$. Find it.

3. The relation $\mathcal{R}$ is defined on $\{1,2,3\ldots\}$ by $x\mathcal{R}y \iff x$ divides $2y$ with no remainder. For each property below either claim $\mathcal{R}$ has that property or claim $\mathcal{R}$ does not have that property and give an example to show it doesn't

A. Reflexive | B. Symmetric | C Antisymmetric | D. Transitive

4 The function $AB\,S_3(C,D,E) + AB'S_0(C,D,E) + A'S'_{2,3,4}(B,C,D,E)$ is a symmetric function of A,B,C,D,E. Write it using the S notation

5. A. Rewrite the state table to right in standard form

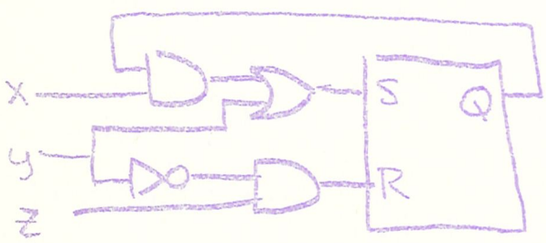
	x=0	x=1
A	C/0	A/0
B	A/0	B/1
C	C/1	D/0
D	A/1	B/1

BCD Carefully "Step by Step" construct the equivalence partition for the state table to the right. Show ALL work.

	x=0	x=1
A	C/0	E/0
B	D/1	F/1
C	E/0	G/0
D	F/1	H/1
E	G/0	G/0
F	H/1	B/1
G	G/0	B/0
H	B/1	D/1

E. Give a minimal length sequence that distinguishes state C from State E.

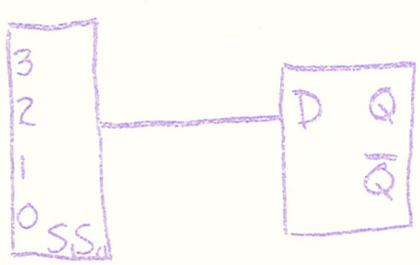
6. AB. Fill in the action Column of the table to right for the circuit below. HOLD, SET, CLEAR, COMPLEMENT AND ~~FORBIDDEN~~ are "ACTIONS"



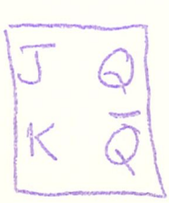
x y z	ACTION
0 0 0	
0 0 1	
0 1 0	
0 1 1	
1 0 0	
1 0 1	
1 1 0	
1 1 1	

C. Use the D flip-flop below and the multiplexer to obtain →

$S_1 S_0$	ACTION
00	HOLDS
01	COMPLEMENTS
10	SETS
11	CLEARS

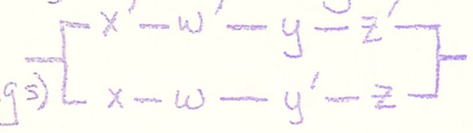


D. Use the decoder and JK flip-flop and no more than two gates to obtain →

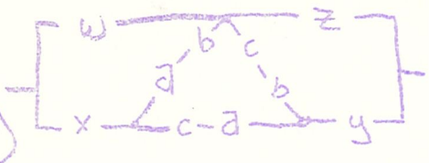


7. Simplify the following contact networks

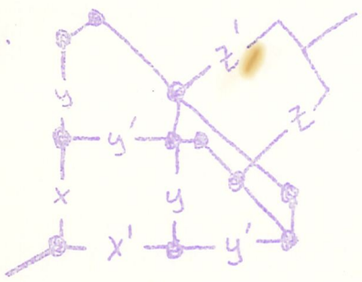
A. (12 springs)



B (7 contacts)



C.



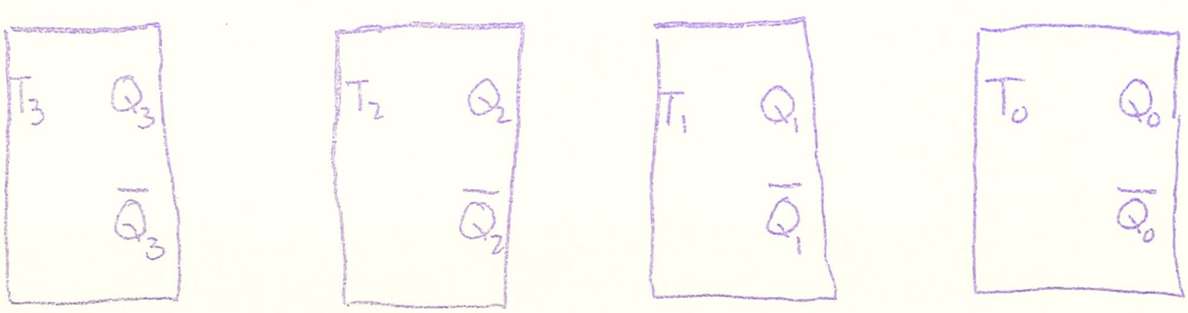
(2pts for 8 springs more for less)

8. Using the T-flip flops below and the control line $C_\wedge$ to realize a circuit which does → (also below)

C	Current state	next state
0	$Q_3Q_2Q_1Q_0$	$Q_3Q_2Q_1Q_0$
1	$Q_3Q_2Q_1Q_0$	$P_3P_2P_1Q_0$

Where $P_i = \begin{cases} Q_i & \text{if } Q_{i-1}, Q_{i-2}, \ldots Q_0 \text{ are all zero} \\ Q_i' & \text{otherwise (i.e if there is a one anywhere to the right)} \end{cases}$

Control Line C ——————————————



DIGITAL ____ by _____

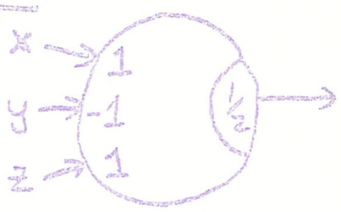
Show Work for Credit 1-4 worth 10pts 5-8 worth 15pts

1. The Hamming Code is used to send a decimal number and the following was Received: 1 1 0 0 0 0 0

A. Assuming at most one error either CIRCLE the bit in error above or SAY there is no error _____

B. What is the decoded message? _____

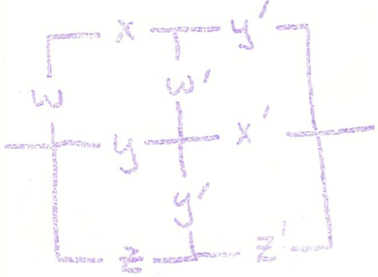
C. Fill in map below for the threshold unit on right



2. For the contact network to right

A. List all tie sets

B. List all cut sets



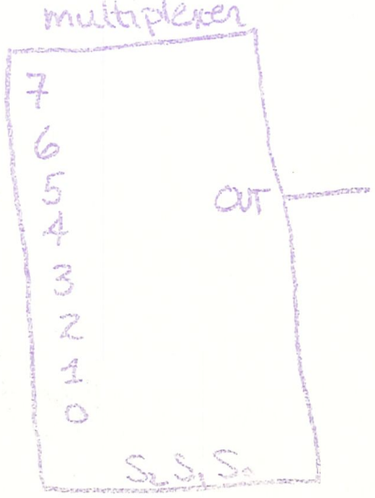
3. CAREFULLY showing ALL work use the TABULATION method to find all prime implicants of $f(x,y,z) = \Sigma(3,4,5,6,7)$ Do NOT construct a prime implicant chart.

4. Realize the function $g(x,y,z) = \Sigma(3,5,6,7)$ using

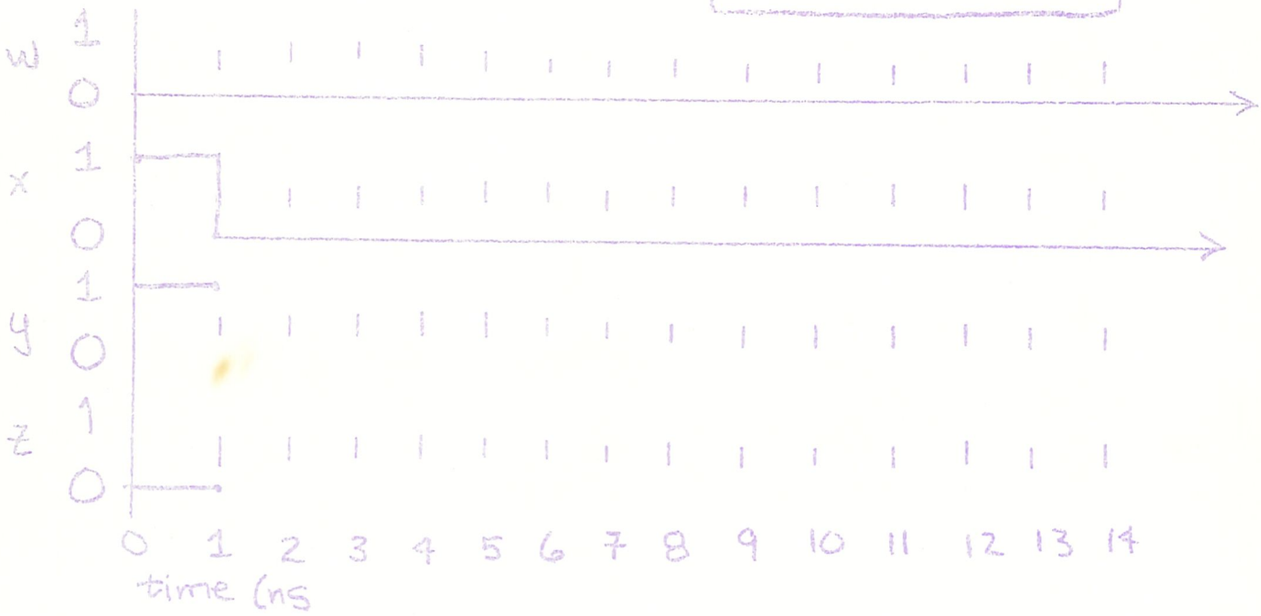
A. The decoder & another gate B. The multiplexer

3x8 decoder

8x1 multiplexer



5. Complete the timing diagram below. Both gates have a delay of one nanosecond. Be sure to include ARROWS

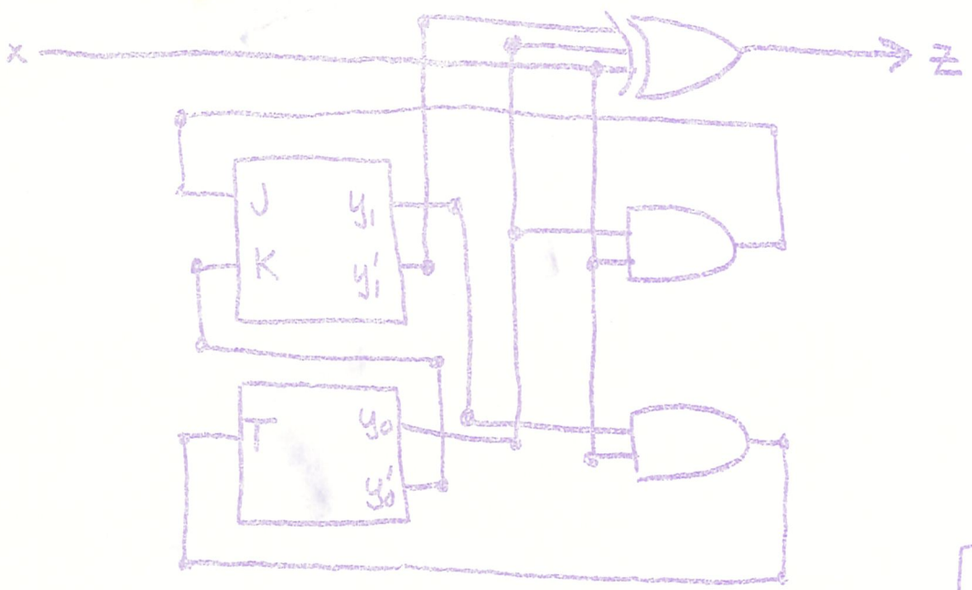


6. Realize the state table below using an RS flip flop and other gates as needed

CURRENT STATE	NEXT STATE / OUTPUT	
	x = 0	x = 1
0	0/0	1/1
1	0/1	0/1

7. Give a state DIAGRAM which will reconize the sequence 000 and the sequence 11 (overlaps o.k) i.e if x = 0010000111 then z = 0000011011
clearly Label which state you start in

8.

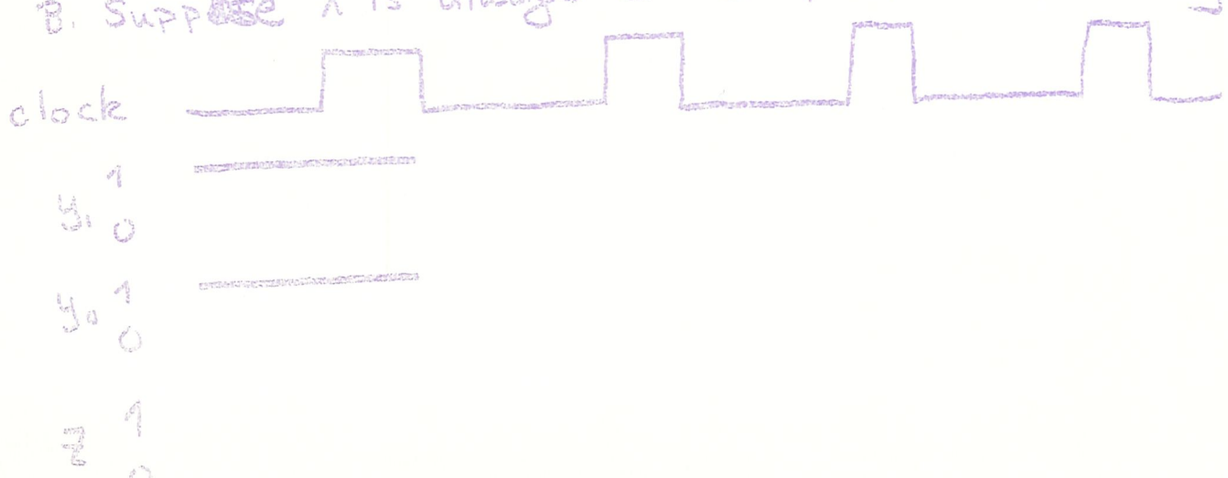


[Flip Flops are negative edge triggered]

A. Complete the state table below

CURRENT STATE $y_1 y_0$	NEXT STATE/OUTPUT x = 0	x = 1
00		
01		
10		
11		

B. Suppose X is always 1 complete the following



Digital
1-8 10 pt each
9-16 15 pt each

1. For the Counter
   a. Give all the
   b. Give all the

2. A. Find All the
   in the Hasse

   B. Write the
   the base

3. Using one or gate
   the function
   (Assume both

4. Give the minimal
   changes in the

CHANGE	
0 to 0	
0 to 1	
1 to 0	
1 to 1	

5. Find a minimal
   with map

6. The relation R on $\{0, 1, 2, 3, \ldots\}$ is defined by $x R y$ if and only if $|x - y| \leq 3$. Answer yes or no and if no give an example which shows why

A. is R reflexive?

B. is R antisymmetric?

C. is R symmetric?

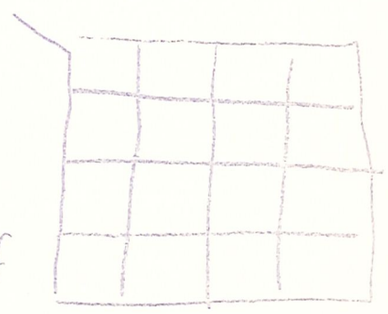
D. is R transitive?

7. Show for ANY boolean algebra $x \oplus (x \oplus y) = y$
$(x \oplus y = xy' + x'y)$

8. Show that $f(x, y, z) = (x' + y)z'$ is functionally complete

9. $f(w, x, y, z) = \sum(0, 2, 4, 9, 12, 15) + \sum_{\phi}(1, 5, 7, 10)$

AB. give a minimal sum of products form for f.



CD. give a minimal product of sums form for f

E1: Is your answer in AB unique? (Yes/No)

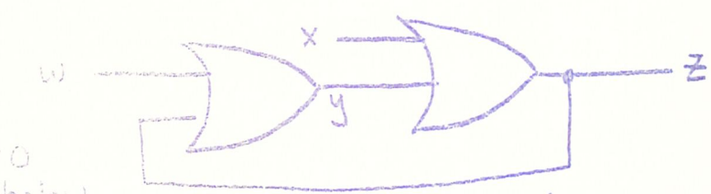
E2: " " " " CD " " " "

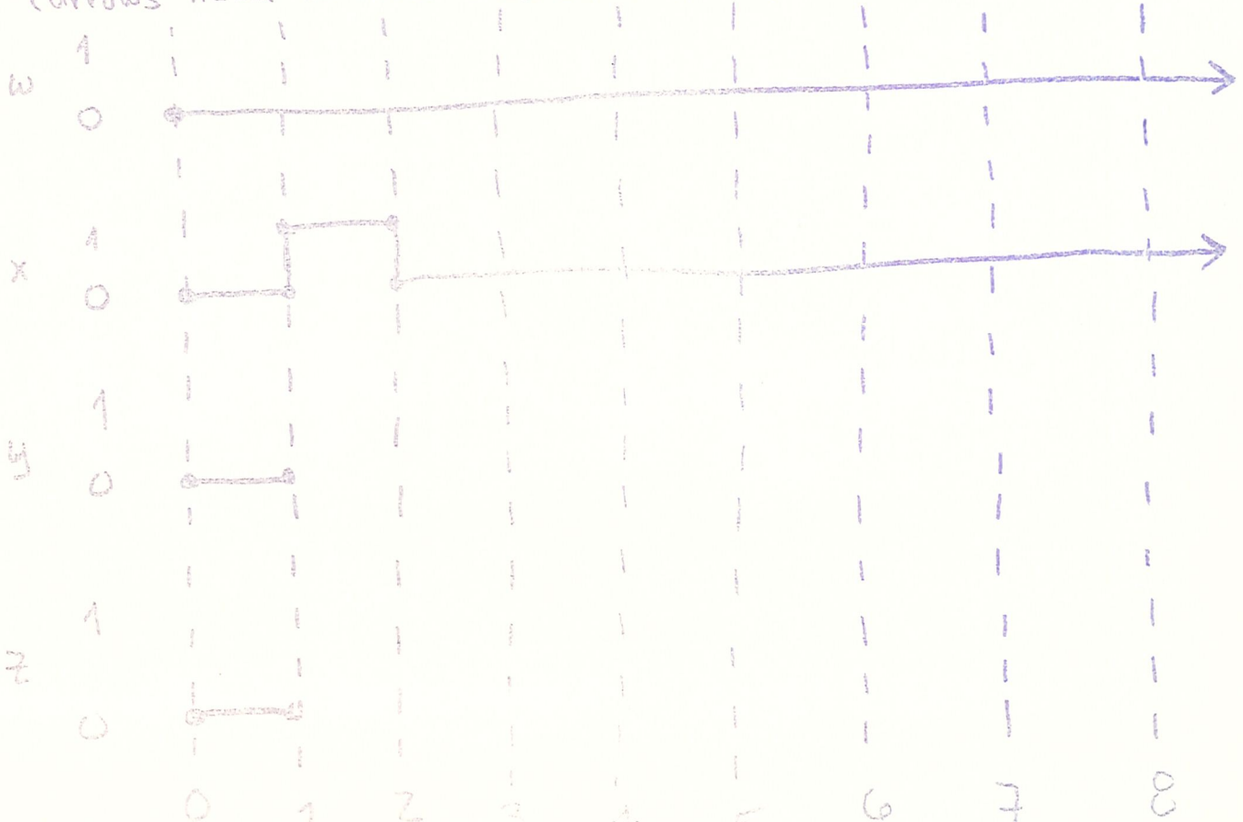
E3: Which of these two [illegible]?

10. Draw a transition graph [illegible] accepts $1(11+0)^*1(11)^*(00)^*1$

11. Use full adders (halves o.k.), a decoder, and other things to realize $S_{0,4,6}(x_1, x_2, \ldots x_7)$

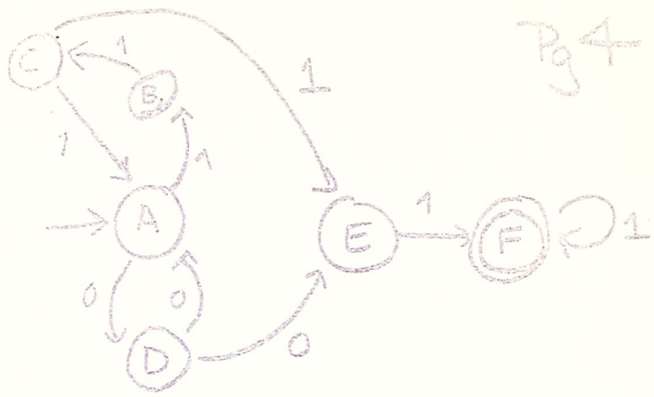
12. Complete the timing diagram. At t=0 w=x=y=z=0
the input x & w change as below
(arrows need to show what causes what) ALL DELAYS = 1ns





13. For the transition graph

A. Write a regular expression for the sequences accepted by it

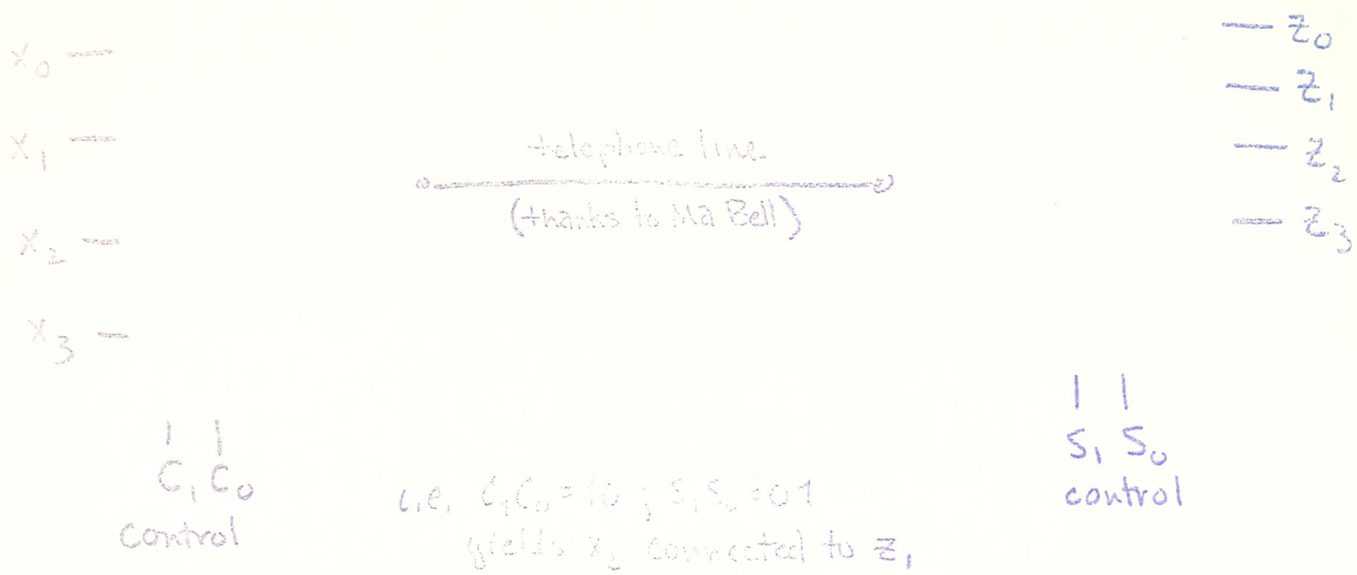


B. Give a state table for an equivalent deterministic machine.

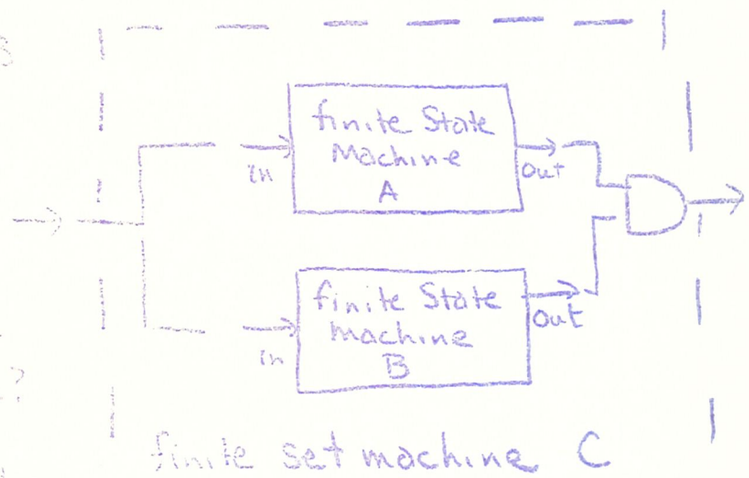
14. Realize the state table to right using a RS flip-flop and some gates

Current State y	Next state/Output	
	x=0	x=1
0	0/1	1/0
1	1/1	0/1

15. Design a way to hook up any of the inputs x_i to any of the output z_j via the phone line. C_1C_0 selects which x_i, S_1S_0 selects which z_j



16. The finite state machines A & B are physical. i.e. A has n flip-flops and B m flip flops plus some other gates.



A. What is the most number of states machine C can have?

BCDE. Explain how this can be used to prove if P and Q are regular expressions, then R, the set of sequences accepted by both P & Q, is regular.

CS 3132 test₂ done by ______________ Row ___ Side ___

SS ______________ (0,1,...) (4/...)

Show all work for Credit #1–4 10 pts each; #5–8 15 pts each

Good luck

1. If x = | 1 | 0 | 1 | 0 | 1 | 0 | and y = | 1 | 0 | 0 | 1 | 1 | 1 |

then A. glb of x & y is | | | | | | |

and B. lub of x & y is | | | | | | |

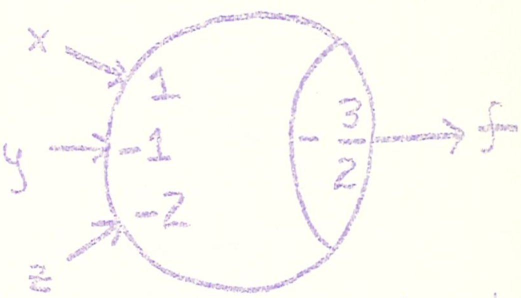
CD Assume there is at most one error in the Hamming code 1 1 1 0 0 1 0

C. Circle the bit in error or say there is none.

D. What is the message?

2. A. Fill in the map for the function given by the threshold unit to right

x \ yz	00	01	11	10
0				
1				



B. Realize the map in 2A with a series-parallel network.

3. For the prime implicant chart to right, implicants AB&C have one less literal than DEF&G.

A. which implicants are essential?

B. which nonessential implicants are in any minimal expression?

C. Which implicants are never used?

	a	b	c	d	e	f	g	h	i	j
A	X		X		X					
B			X							X
C								X	X	X
D	X	X								
E				X	X					
F						X		X		
G							X		X	

4. The relation R on the set N = {0, 1, 2, ...} is defined by x R y if and only if x ≤ y + 3. Answer yes or no to the following & if your answer is no give an example that shows why.

A. is R reflexive?

B. is R symmetric?

C. is R antisymmetric?

D. is R transitive?

SHOW ALL WORK 1-8 10 pts each 9-16 15 pts each.

1. A. "XOR" the two 8-bit registers containing $(AB)_{16}$ and $(47)_{16}$ and express the outcome in hexidecimal.

   B. For the same register pairs express their g.l.b. in hexidecimal.

2. A. Encode 6 into Hamming code

   B. The function $S_{2345}(v\,w\,x\,y\,z)$ can be realized using one threshold unit. Do it.

3. A. Use our technique for map entered variables to find a minimal expression for the map →

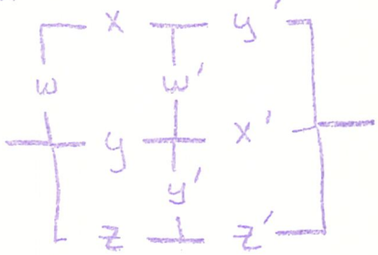
z \ xy	00	01	11	10
0	A	A	A	0
1	B	∅	1	A′

   B. Use this 8x1 multiplexer to realize this map.

4. For the contact network to right

   A. List all tie sets

   B List all cutsets



5. The function $A\,S_{02}(B',C',D',E') + A'\,S'_{124}(B,C,D,E)$ is a symmetric function of A, B, C, D, E. Write it using the S notation.

6. The relation R is defined on $\{1,2,3,\ldots\}$ by $xRy \Leftrightarrow x-y=3$
   For each property below either state R has that property OR state that it doesn't have the property and give an example to show it doesn't

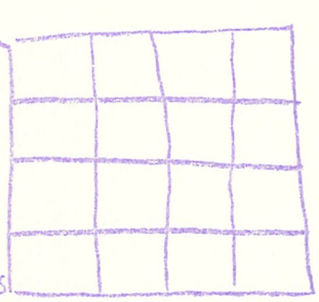
A Reflexive | B. Symmetric | C. Antisymmetric | D transitive

7. Show $f(x,y,z) = x' + yz'$ is functionally complete

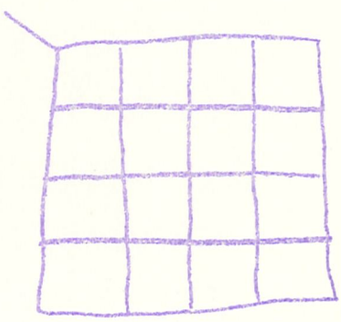
8. Give a state diagram which reconizes the sequence
001, 0001, 00001, ..., $\underbrace{0 \cdots\cdots 0}_{\text{two or more zero's}}1$, ... Clearly label your starting state

9. For $f(w,x,y,z) = \Sigma(0,2,4,6,7,10) + \Sigma_\phi(3,5,8,15)$

AB Find all minimal sum of products expressions for f



CD Find all minimal product of sums expressions for f



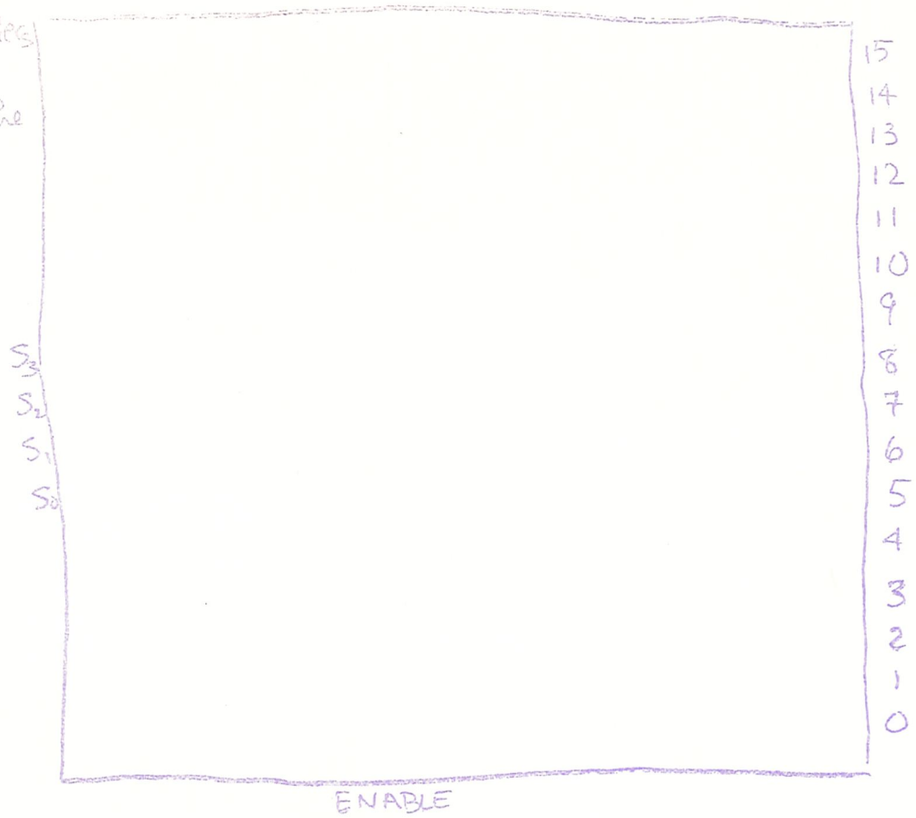
E. Which are minimal overall?

10. Define or state what it means
A. Symmetric function $f(x,y,z)$

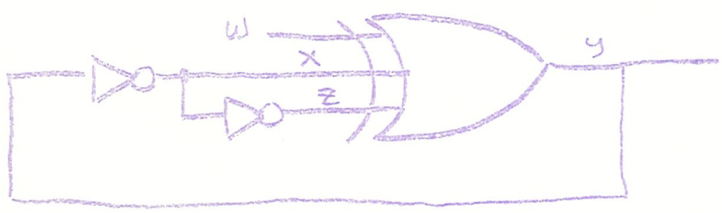
B. Irreflexive relation R on $\overline{X}$

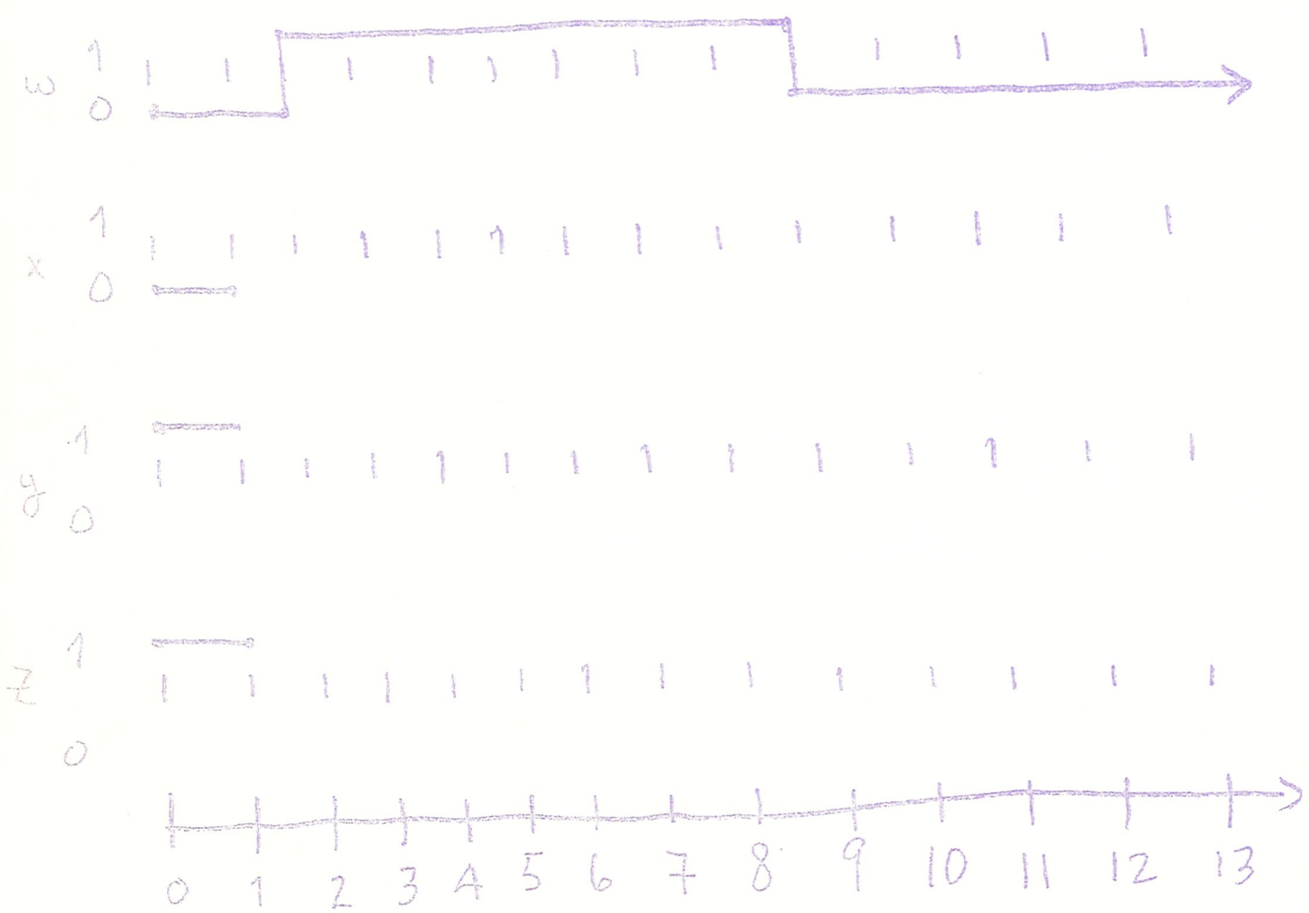
C. the sup of $x \& y$

11. Use 5 2x4 decoders with enable (like one below) inside the box to realize the 4x16 decoder shown

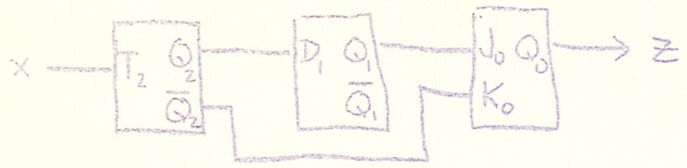


12. Complete the timing diagram below. All gates have 1 ns delay ARROWS are required



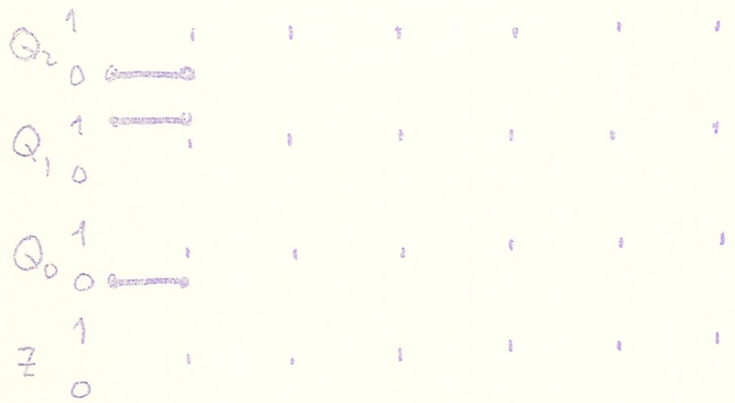


13. A: Fill in the state table to right for the circuit below



$Q_2Q_1Q_0$	NEXT STATE / OUTPUT x=0	x=1
000		
001		
010		
011		
100		
101		
110		
111		

B Complete the following assuming the input x is always 1



14 Realize the state table below using two JK flip flops and as few gates as possible.

Q_1Q_0	x=0	x=1
00	11/0	10/0
01	01/0	10/0
11	10/1	00/1
10	11/0	00/0

Note gray order

15. Prove or Disprove. (For Any Boolean Algebra)

A. $xy + x'z = [(x'+y')(x+z')(yz)']'$

B. $x'y + xz + x'z = yz + x'z + y'z + x'y'z' + x'y + xy'z'$

16. Prove by INDUCTION: No matter which state you start in, after the input sequence for $n \geq 0$

1101 0001 0001 ... 0001

(n repetitions)

the current output is 1 and the next state is C

	X=0	X=1
A	D/0	A/0
B	A/0	A/0
C	B/0	A/0
D	D/0	C/1