NORTH SOUTH UNIVERSITY

CSE-231 Digital Logic Design
Section: 07
Faculty: MD. SHAHRIAR HUSSAIN (HSM)

Project
Fall 2021

Name:	Ferdous Hasan Zihad Akash	ID:	2021309642

Date of Submission: 1st[th] January, 2022

Contents:

Part 1: Combinational part

- Basic gates implementations
- Universal gate(NAND) implementation(page
- Decoder implementation
- Multiplixer implementation(page-

Part 2: Sequential part:

- Decoder Sequential circuit implementation

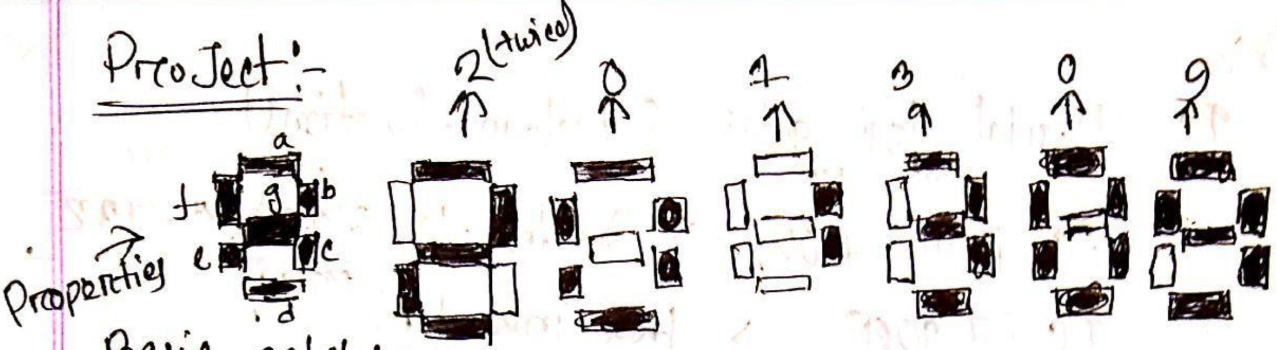
For Instructor's use only

SCORE:	REMARKS:
PENALTY:	

Name:- Ferdous Hasan Zihad Akash

ID:- 2021309642

Project:-



Basic gates:-

ID	A B C	a	b	c	d	e	f	g
2	0 0 0	1	1	0	1	1	0	1
0	0 0 1	1	1	1	1	1	1	0
2	0 1 0	1	1	0	1	1		1
1	0 1 1	0	1	1	0	0	0	0
3	1 0 0	1	1	1	1	0	0	1
0	1 0 1	1	1	1	1	1	1	0
9	1 1 0	1	1	1	1	0	1	1
	1 1 1	x	x	x	x	x	x	x

equation for:-

$a = \Sigma(1110111x)$ $\quad$ $b = \Sigma(1111111x)$

$c = \Sigma(0101111x)$ $\quad$ $d = \Sigma(1110111x)$

$e = \Sigma(1110010x)$ $\quad$ $f = \Sigma(0100011x)$

$g = \Sigma(1010101x)$

Solving K-map:- (basic gate)

$a = \Sigma(1110111X)$

	$\bar{B}$		B	
$\bar{A}$	1	1	0	1
A	1	1	X	1
		C		$\bar{C}$

$a = \bar{B} + \bar{C}$

$b = \Sigma(1111111X)$

	$\bar{B}$		B	
$\bar{A}$	1	1	1	1
A	1	1	X	1
		C		$\bar{C}$

$b = 1$

$c = \Sigma(0101111X)$

	$\bar{B}$		B	
$\bar{A}$	0	1	1	0
A	1	1	X	1
		C		$\bar{C}$

$c = C + A$

$d = \Sigma(1110111X)$

	$\bar{B}$		B	
$\bar{A}$	1	1	0	1
A	1	1	X	1
		C		$\bar{C}$

$d = \bar{B} + \bar{C}$

$e = \Sigma(1110010X)$

	$\bar{B}$		B	
$\bar{A}$	1	1	0	1
A	0	1	X	0
		C		$\bar{C}$

$e = \bar{A}\bar{C} + \bar{B}C$

$f = \Sigma(0100011X)$

	$\bar{B}$		B	
$\bar{A}$	0	1	0	0
A	0	1	X	1
		C		$\bar{C}$

$f = \bar{B}C + AB$

$g = \Sigma(1010101X)$

	$\bar{B}$		B	
$\bar{A}$	1	0	0	1
A	1	0	0	1
		C		$\bar{C}$

$g = \bar{C}$

equation for Basic gates:-

$a = B + C$

$b = 1$

$c = C + A$

$d = \overline{B} + \overline{C}$

$e = \overline{A}\,\overline{C} + \overline{B}C$

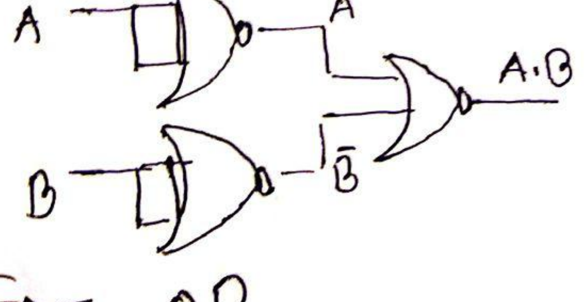
$f = \overline{B}C + AB$

$g = \overline{C}$

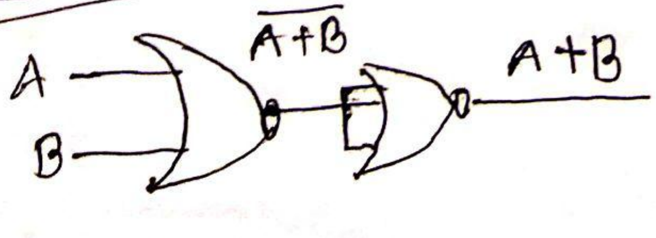
Universal gate implementation:-

For universal gate I've used the basic equation then I converted those equations to NAND gate. Which is a universal gate.

For AND I → used:-



For OR



Using Decoders :-

used minterms from the basic gate :-
Simplified equations.

eq :-

$a = \Sigma(1110111 1x)$

$b = \Sigma(11111111x)$

$c = \Sigma(01011111x)$

$d = \Sigma(11101111x)$

$e' = \Sigma(11100010x)$

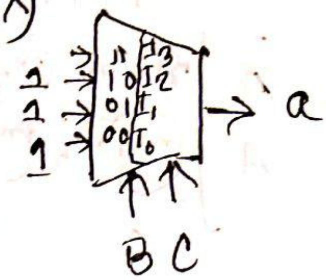
$f = \Sigma(01000011x)$

$g = \Sigma(10101011x)$

Using Mux:-

$\Sigma(1110111x)$

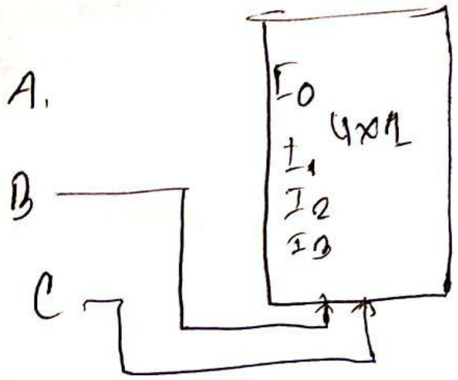
$a =$



A	B	C
0	0	0
0	0	1
0	1	0
0	1	1
1	0	0
1	0	1
1	1	0
1	1	1

$a =$ BC

	00 I_0	01 I_1	10 I_2	11 I_3
$\bar{A}$	m_0	m_1	m_2	m_3
A	m_4	m_5	m_6	m_7
	1	1	1	0



$b = \Sigma(1111111x)$

	I_0	I_1	I_2	I_3
$\bar{A}$	m_0	m_1	m_2	m_3
A	m_4	m_5	m_6	m_7
	1	1	1	$\bar{A}$

$c = \Sigma(0101111x)$

	I_0	I_1	I_2	I_3
$\bar{A}$	m_0	m_1	m_2	m_3
A	m_4	m_5	m_6	m_7
	A	1	A	$\bar{A}$

$d = \Sigma(1110111x)$

	I_0	I_1	I_2	I_3
$\bar{A}$	m_0	m_1	m_2	m_3
A	m_4	m_5	m_6	m_7
	=1	1	1	0

$e = \Sigma(110010x)$

	I_0	I_1	I_2	I_3
$\bar{A}$	m_0	m_1	m_2	m_3
A	m_4	m_5	m_6	m_7
	$\bar{A}$	1	$\bar{A}$	0

$f = \Sigma(0100011x)$

	I_0	I_1	I_2	I_3
$\bar{A}$	m_0	m_1	m_2	m_3
A	m_4	m_5	m_6	m_7
	0	1	A	0

$g = \Sigma(1010101x)$

	I_0	I_1	I_2	I_3
$\bar{A}$	m_0	m_1	m_2	m_3
A	m_4	m_5	m_6	m_7
	1	0	1	0

equation for MUX:-

$a = 1110$

$b = 111\bar{A}$

$c = A1A\bar{A}$

$d = 1110$

$e = \bar{A}1\bar{A}0$

$f = 01A0$

$g = 1010$

Synchronous counter:-

State Diagram:-

2 → 0 → 2 → 1 → 3 → 0 → 9 → 0

State table:-

$A_{(t)}$ $B_{(t)}$ $C_{(t)}$	$A_{(t+1)}$ $B_{(t+1)}$ $C_{(t+1)}$	J_A K_A	J_B K_B	J_C K_C
0 0 0	0 0 1	0X	0X	1X
0 0 1	0 1 0	0X	1X	X1
0 1 0	0 1 1	0X	X0	1X
0 1 1	1 0 0	1X	X1	X1
1 0 0	1 0 1	X0	0X	1X
1 0 1	1 1 0	X0	1X	X1
1 1 0	0 0 0	X1	X1	0X
1 1 1	X X X	X X	X X	X X

State equations:-

$J_A = \Sigma(0001XXXX)$

$J_B = \Sigma(01XX01XX)$

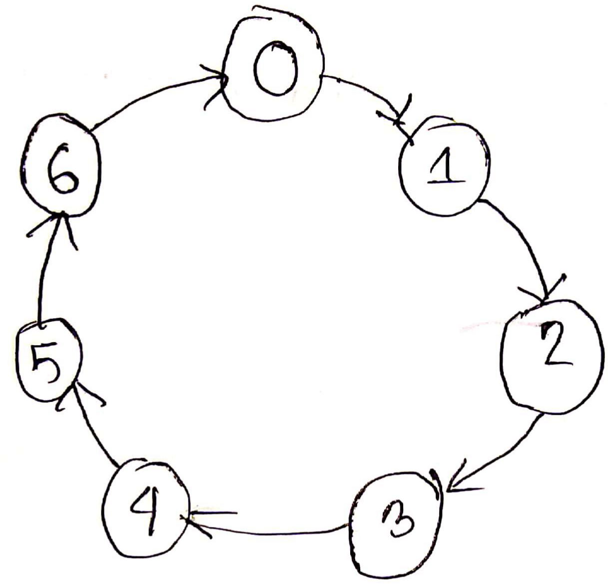
$J_C = \Sigma(1X1X1X0X)$

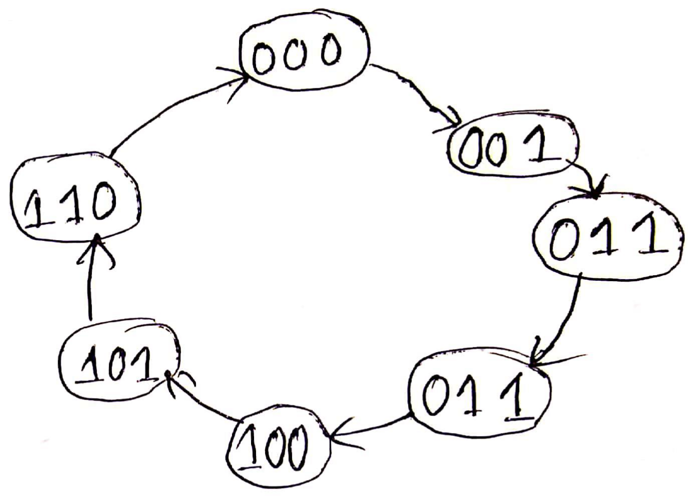
$K_A = \Sigma(XXXX001X)$

$K_B = \Sigma(XX01XX1X)$

$K_C = \Sigma(X1X1X1XX)$

State Diagram:-





K - map for Sequential Part :-

$J_A = \Sigma(0001XXXX)$ $\quad$ $J_B = \Sigma(01XX01XX)$

$A_{(t)} \backslash B_{(t)}C_{(t)}$				
	0	0	1	0
	X	X	X	X

$J_A = B_{(t)}C_{(t)}$

$A_{(t)} \backslash B_{(t)}C_{(t)}$				
	0	1	X	X
	0	1	X	X

$J_B = C_{(t)}$

$J_C = \Sigma(1X1X1X1X)$

1	X	X	1
1	X	X	0

$J_C = 1 \quad \overline{A}_{(t)} + \overline{B}_{(t)}$

K-map :-

$K_A \Sigma(x\,x\,x\,x\,0\,0\,1\,x)$

=

x	x	x	x
0	0	x	1

$K_A = B_{(t)}$

$K_B = \Sigma(x\,x\,0\,1\,x\,x\,1\,x)$

x	x	1	0
x	x	x	1

$K_B = C_{(t)} + A_{(t)}$

$K_C = \Sigma(x\,1\,x\,1\,x\,1\,x\,x)$

x	1	1	x
x	1	x	x

$K_C = 1$

equation for sequential ckt :-

$$J_A = B(t)\,C(t)$$

$$J_B = C(t)$$

$$J_C = \bar{A}(t) + \bar{B}(t)$$

$$K_A = B(t)$$

$$K_B = C(t) + A(t)$$

$$K_C = 1$$