Course Code: CSUA21175 Branch: Comp. Engg.

Sub: DSLD

Marking Scheme for DSLD. U218-125(T1)

Q.1) a)

K-Map - 2 Mark

Logical expression - 1 Mark

Logic Circuit Diagram - 3 Mark.

Q.1) b)

Step1: Binary equivalent of group minterm table - 2 Marks.

Step2: List of prime implicant table - 1 Mark.

Step3: Table of matched and unmatched minterm + 1 Mark

Step4: Essential Prime implicant table - 1 Mark.

Step5: final terms representation - 1 Marks.

Q.1) c) i)

Binary conversion of integral part - 1 mark

Binary conversion of fractional part - 1 Mark.

Q.1) c) ii) sum of powers of 2's term - 1 Mark.

Binary representation - 1 Mark.

Q.2) a) Step1: Canonical SOP form - 1 Marks.

Step2: K-map - 2 Marks

Step3: Logical Circuit Diagram - 2 Marks.

Step4: Expression - 1 Marks.

Q.2) b) Step1: find out minterm and Binary equivalent of group minterm table - 2 Marks.

Step2 to Step5 -> same as Q.1 b).

Q.2) c) Step 1: find Binary equivalent of number - 2 Marks

Step 2: Write 8 bit positive number and 2's complement. - 2 Marks.

Q.3) a) table conversion (BCD to Excess-3) - 2 Marks

K-map - 2 Marks.

Logic circuit diagram - 2 Marks.

Q.3) b) ~~B~~ Cascading of tree structure - 3 Marks.

table - 1 Mark.

Q.3) c) table - 1 Marks

K-Map - 1 Mark

Expression - 1 Mark.

Circuit Diagram - 1 Mark.

Q.4) A) - standard SOP form expression - 3 Marks.

- Multiplexer Structure - 3 Marks.

Q.4) B) Truth Table - 1 Mark.

~~3:8~~ Expression - 1 Mark.

3:8 Decoder structure - 2 Mark.

Q.4) C). Truth table - 1 Mark.

K-map - 1 Mark.

Expression - 1 Mark.

Circuit Diagram - 1 Mark.

Solution & Model Answer.

U218-125(T1)

Total No. of Questions – [04]

Total No. of Printed Pages 02

G.R. No.	

OCTOBER 2018/ IN-SEM (T1)

S. Y. B. TECH. (COMPUTER ENGINEERING) (SEMESTER - I)

COURSE NAME: DIGITAL SYSTEMS AND LOGIC DESIGN

COURSE CODE: CSUA21175

(PATTERN 2017)

Time: [**1 Hour**]

[Max. Marks: **30**]

Instructions to candidates:

1) **Answer Q.1 OR Q.2 and Q.3 OR Q.4.**
2) **Figures to the right indicate full marks.**
3) **Use of scientific calculator is allowed**
4) **Use suitable data whenever required.**

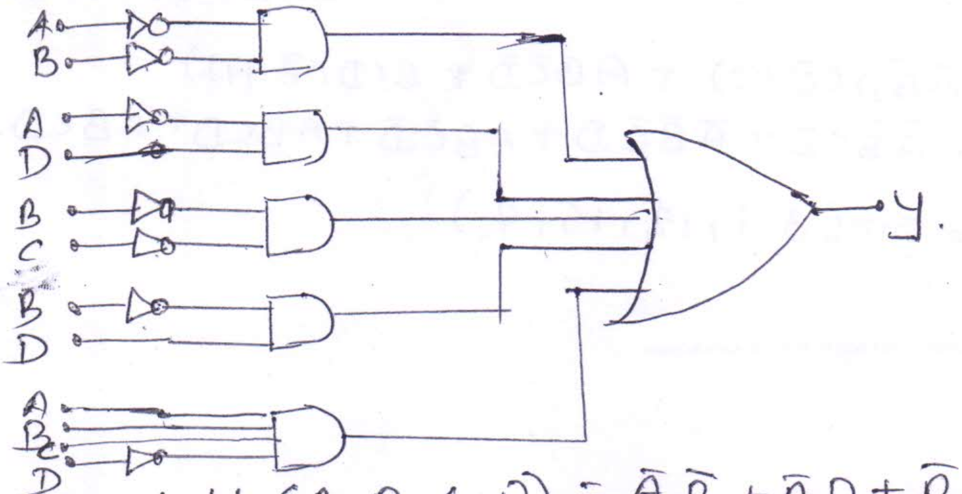
Q.1) a)

$y(A,B,C,D) = \Sigma m(0,1,2,3,5,7,8,9,11,14)$. [6M]

- The logical function is $y(A,B,C,D) = \bar{A}\bar{B} + \bar{A}D + \bar{B}\bar{C} + \bar{B}D + ABC\bar{D}$.

CD \ AB	00	01	11	10
00	1			1
01	1	1		1
11	1	1		1
10	1		1	

$y(A,B,C,D) = \bar{A}\bar{B} + \bar{A}D + \bar{B}\bar{C} + \bar{B}D + ABC\bar{D}$



$\therefore y(A,B,C,D) = \bar{A}\bar{B} + \bar{A}D + \bar{B}\bar{C} + \bar{B}D + ABC\bar{D}$

Q.1)b).

b)

step 1:

Minterm	Binary	Minterm	Binary
m2	0010	m2	0010
m4	0100	m4	0100✓
m5	0101	m5	0101✓
m9	1001	m9	1001✓
m12	1100	m12	1100✓
m13	1101	m13	1101✓

Binary equivalents of groups of minterms.

step 2 [6]

minterms	Binary	Minterm	Binary
4,5	010-✓	4,5,12,13	-10-
4,12	-100✓		
5,13	-101✓		
9,13	1-01✓		
12,13	110-✓		

The list of prime implicant

step 3

Prime implicants	Binary
2	0010
9,13	1-01
4,5,12,13	-10-

step 4

Prime implicants	m_2	m_4	m_5	m_9	m_{12}	m_{13}
2		●				
9,13				●		●
4,5,12,13		●	●		●	●

Step5: $Y(A,B,C,D) = (1-01) + (-10-)$

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

(Q.1) c) $(109)_{10} = (1101101)_2$ + fractional part of the given number is 0.125. [4]

$(109.125)_{10}$

	Quotient	Remainder
109 ÷ 2	54	1 LSB
54 ÷ 2	27	0
27 ÷ 2	13	1
13 ÷ 2	06	1
06 ÷ 2	3	0
3 ÷ 2	1	1
1 ÷ 2	0	1 MSB

Multiplication	Integral part
$0.125 \times 2 = 0.250$	0 MSB
$0.25 \times 2 = 0.50$	0
$0.5 \times 2 = 1.0$	1 LSB

$(0.125)_{10} = (0.001)_2$

OR $(109.125)_{10} = (1101101)_2 + (0.001)_2 = (1101101.001)_2$.

[6]

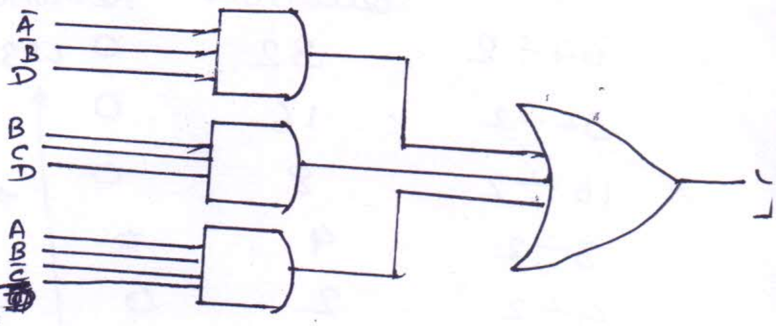
Q2) a)

$Y(A,B,C,D) = \bar{A}\bar{B}D(\bar{C}+C) + AB\bar{C}\bar{D} + BCD(\bar{A}+A)$

$= \bar{A}\bar{B}CD + \bar{A}\bar{B}\bar{C}D + AB\bar{C}\bar{D} + ABCD + \bar{A}BCD.$

$Y(A,B,C,D) = \Sigma m(3,1,12,15,7)$

CD \ AB	00	01	11	10
00			1	
01	1			
11	1	1	1	
10				



$Y(A,B,C,D) = \bar{A}\bar{B}D + BCD + AB\bar{C}\bar{D}$

Q.2) b). $Y(A,B,C,D) = \pi M(1,4,6,9,10,11,14,15)$ [6]

$Y(A,B,C,D) = \Sigma m(0,2,3,5,7,8,12,13)$.

Minterms	Binary	Minterm	Binary
m_0	0000	m_0	0000 ✓
m_2	0010	m_2	0010 ✓
m_3	0011	m_8	1000 ✓
m_5	0101	m_3	0011 ✓
m_7	0111	m_{12}	1100 ✓
m_8	1000	m_5	0101 ✓
m_{12}	1100	m_7	0111 ✓
m_{13}	1101	m_{13}	1101 ✓

Minterm in binary equivalent & group of minterms.

Minterm	Binary	Minterm	Bina
0,2	00-0	NIL	NIL
0,8	-000		
2,3	001-		
8,12	1-00		
3,7	0-11		
5,7	01-1		
5,13	-101		
12,13	110-		

Binary equivalent of group of minterms with check marks.

Prime implicents	Binary
0,2	00-0
0,8	-000
2,3	001-
8,12	1-00
3,7	0-11
5,7	01-1
5,13	-101
12,13	110-

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List of Prime implicants

~~Prime implicants m_{13} m_0 m_2 m_3 m_5 m_7 m_8 m_1~~

Prime implicants	m_0	m_2	m_3	m_5	m_7	m_8	m_{12}	m_{13}
0,2 ✓	•	•						
0,8 ✓	•					•		
2,3		•	•					
8,12						•	•	
3,7			•		•			
5,7				•	•			
5,13				•				•
12,13							•	•

Prime implicant selection

$$f(A,B,C,D) = (110\_) + (\_101) + (01\_1) + (\_000) + (00\_0)$$
$$= AB\bar{C} + B\bar{C}D + \bar{A}CD + \bar{B}\bar{C}\bar{D} + \bar{A}\bar{B}\bar{D}$$ (4)

[4]

Q.2) c) $(64)_{10}$

	Quotient	Remainder
$64 \div 2$	32	0 LSB
$32 \div 2$	16	0
$16 \div 2$	8	0
$8 \div 2$	4	0
$4 \div 2$	2	0
$2 \div 2$	1	0
$1 \div 2$	0	1 MSB.

→ $(64)_{10} = (1000000)_2$

→ Positive number using 8-bits.

$(+64)_{10} = (01000000)_2$

→ 2's complement represents of +ve nos is same as the sign magnitude represent of positive numbers.

Q3) a)

[6]

Decimal Digit	BCD code B_3 B_2 B_1 B_0	Excess-3 code E_3 E_2 E_1 E_0
0	0 0 0 0	0 0 1 1
1	0 0 0 1	0 1 0 0
2	0 0 1 0	0 1 0 1
3	0 0 1 1	0 1 1 0
4	0 1 0 0	0 1 1 1
5	0 1 0 1	1 0 0 0
6	0 1 1 0	1 0 0 1
7	0 1 1 1	1 0 1 0
8	1 0 0 0	1 0 1 1
9	1 0 0 1	1 1 0 0

[4]

B_1B_0 \ B_3B_2	00	01	11	10
00	0	0	X	1
01	0	1	X	1
11	0	1	X	X
10	0	1	X	X

K-map for $E_3 = B_3 + B_2B_0 + B_2B_1$

B_1B_0 \ B_3B_2	00	01	11	10
00	0	1	X	0
01	1	0	X	1
11	1	0	X	X
10	1	0	X	X

$E_2 = \bar{B}_2B_0 + \bar{B}_2B_1 + B_2\bar{B}_1\bar{B}_0$

B_1B_0 \ B_3B_2	00	01	11	10
00	1	1	X	1
01	0	0	X	0
11	1	1	X	X
10	0	0	X	X

$E_1 = \overline{B_1}\,\overline{B_0} + B_1 B_0$

B_1B_0 \ B_3B_2	00	01	11	10
00	1	1	X	1
01	0	0	X	0
11	0	0	X	X
10	1	1	X	X

$E_0 = \overline{B_0}$

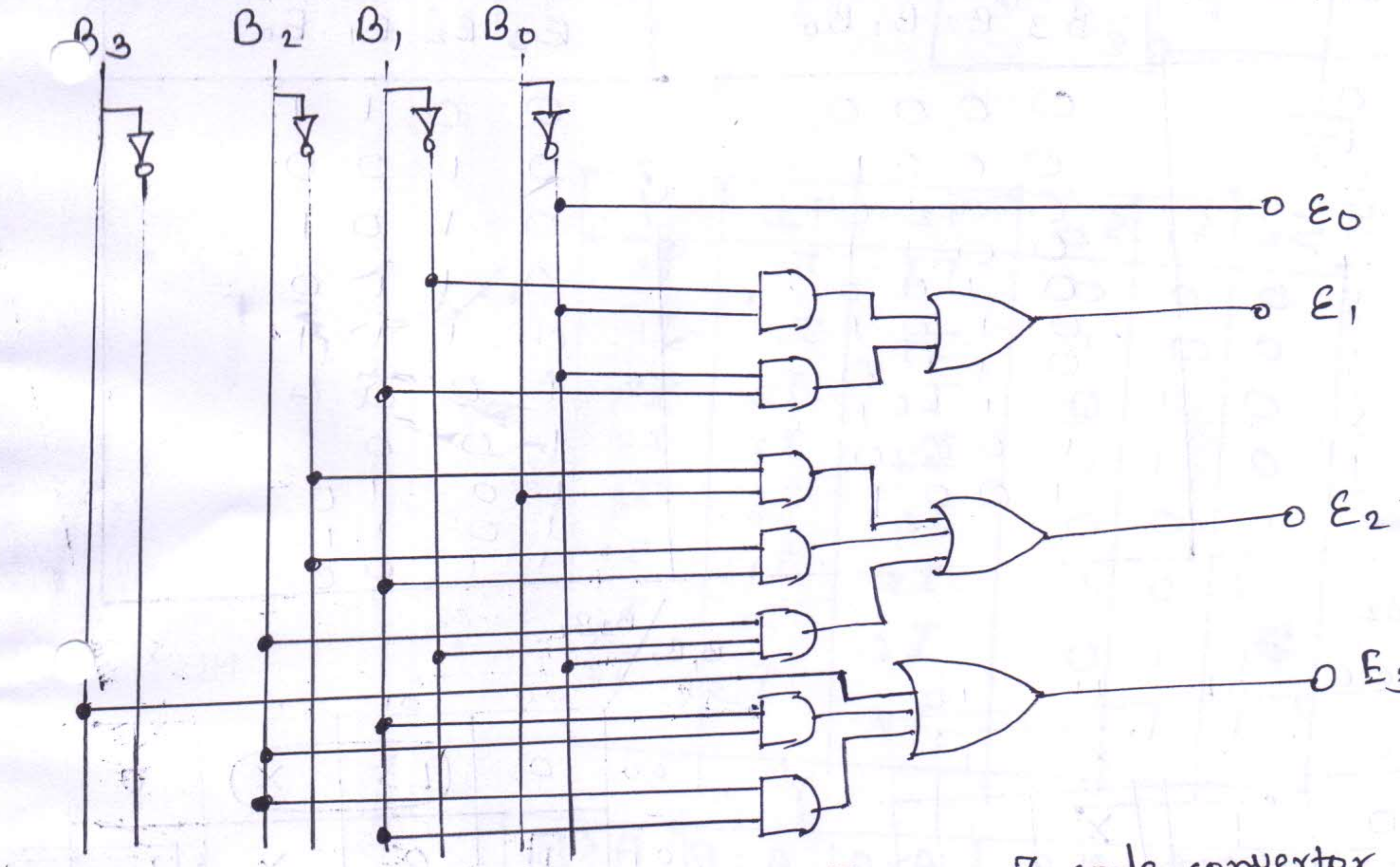
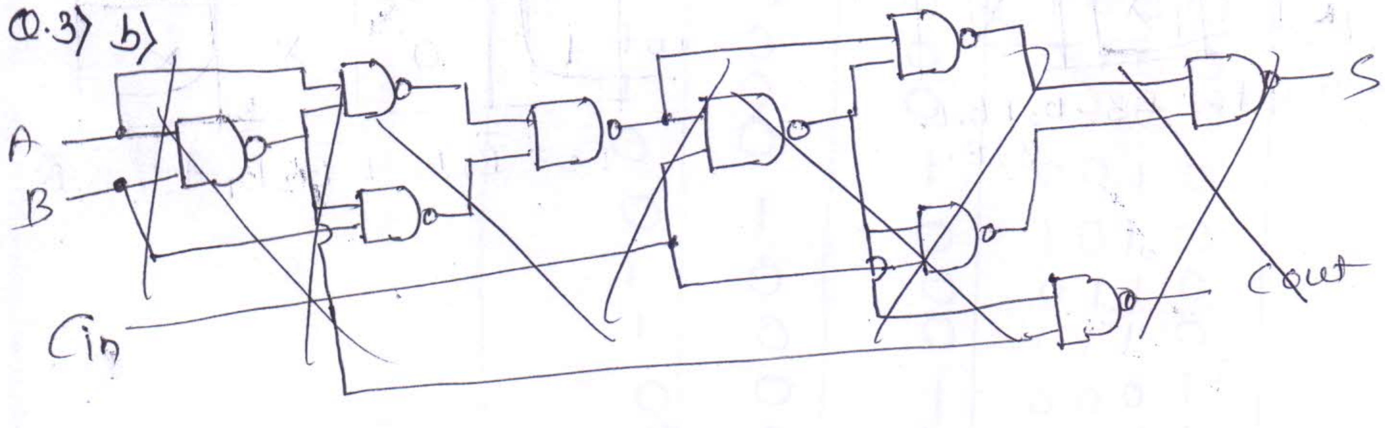
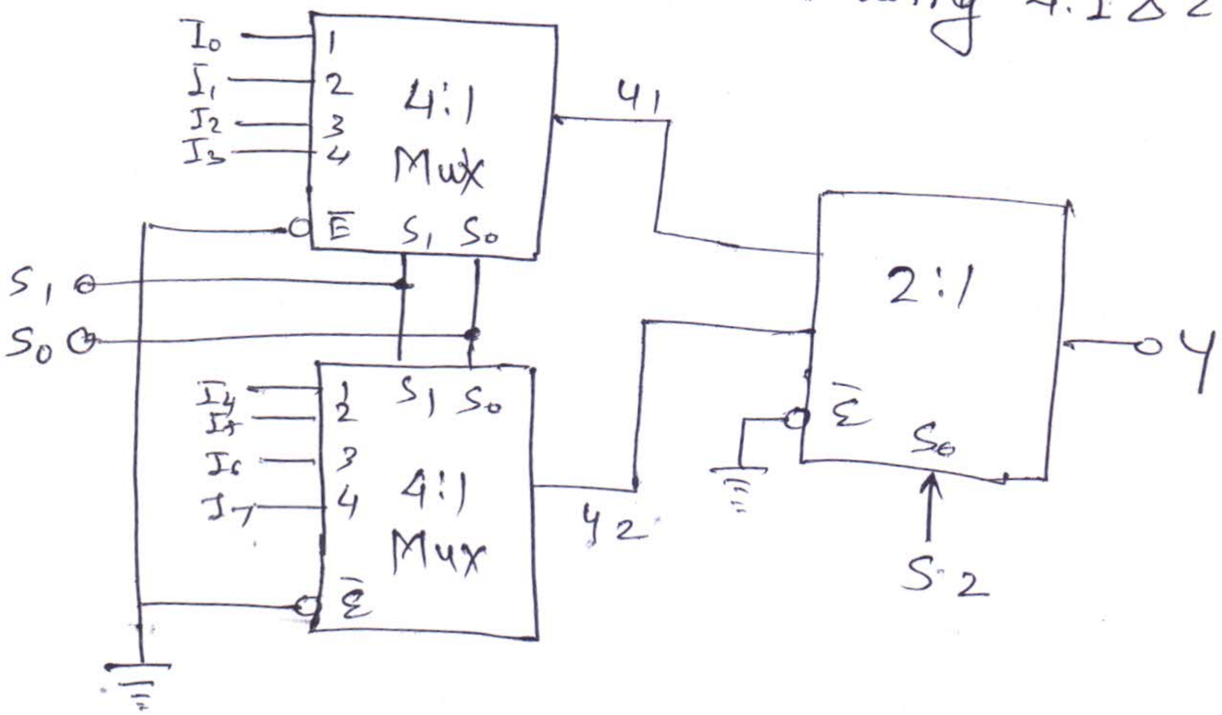


fig: 4-Bit BCD to Excess-3 code converter

Q.3) b)



Q·3) b) Implement 8:1 Mux using 4:1 & 2:1 Mux.



S_2	S_1	S_0	Y_2	Y_1	Y
0	0	0	I_4	I_0	I_0
0	0	1	I_5	I_1	I_1
0	1	0	I_6	I_2	I_2
0	1	1	I_7	I_3	I_3
1	0	0	I_4	I_0	I_4
1	0	1	I_5	I_1	I_5
1	1	0	I_6	I_2	I_6
1	1	1	I_7	I_3	I_7

Q.3) c)

$A_1 A_2 B_1 B_2$	$A>B$	$A=B$	$A<B$.
0 0 0 0	0	1	0
0 0 0 1	0	0	1
0 0 1 0	0	0	1
0 0 1 1	0	0	1
0 1 0 0	1	0	0
0 1 0 1	0	1	0
0 1 1 0	0	0	1
0 1 1 1	0	0	1
1 0 0 0	1	0	0
1 0 0 1	1	0	0

A_1	A_2	B_1	B_2	$A>B$	$A=B$	$A<B$
1	0	1	0	0	1	0
1	0	1	1	0	0	1
1	1	0	0	1	0	0
1	1	0	1	1	0	0
1	1	1	0	1	0	0
1	1	1	1	0	1	0

B_1B_0 \ A_1A_0	00	01	11	10
00	0	1	1	1
01	0	0	1	1
11	0	0	0	0
10	0	0	1	0

Kap for A>B

B_1B_0 \ A_1A_0	00	01	11	10
00	1	0	0	0
01	0	1	0	0
11	0	0	1	0
10	0	0	0	1

Map for A =0.

B_1B_0 \ A_1A_0	00	01	11	10
00	0	0	0	0
01	1	0	0	0
11	1	1	0	1
10	1	1	0	0

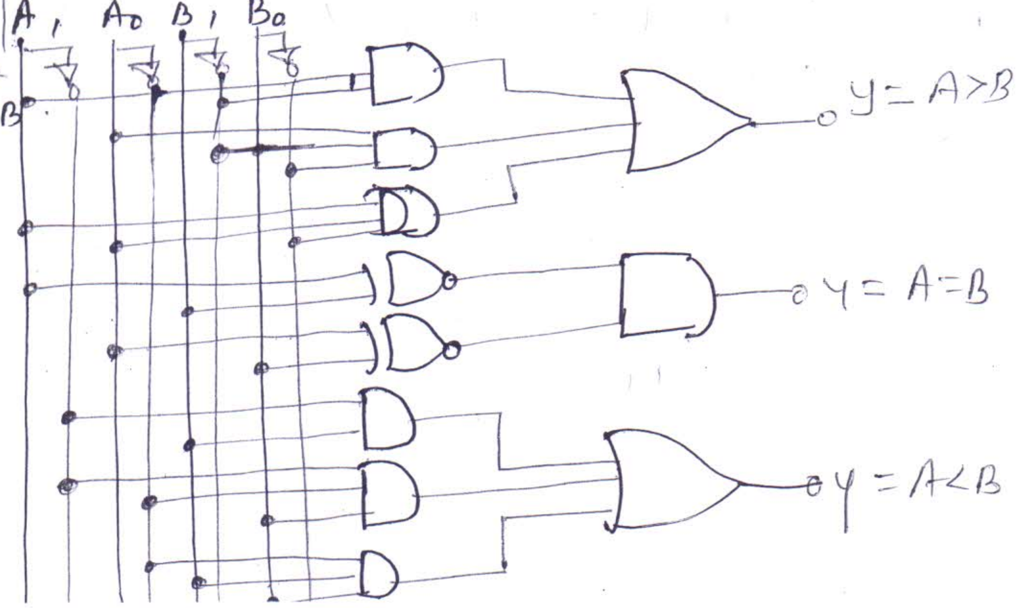
Kmap for A<B.

$$(A>B) = A_1\bar{B}_1 + A_0\bar{B}_1\bar{B}_0 + A_1A_0\bar{B}_0$$

$$(A=B) = \bar{A}_1\bar{B}_1\bar{A}_0\bar{B}_0 + \bar{A}_1A_0\bar{B}_1B_0 + A_1A_0B_1B_0 + A_1\bar{A}_0B_1\bar{B}_0$$

$$= (A_0 \odot B_0)(A_1 \odot B_1)$$

$$(A<B) = \bar{A}_1B_1 + \bar{A}_1\bar{A}_0B_0 + \bar{A}_0B_1B_0$$

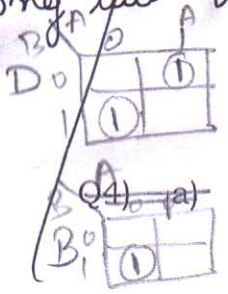


5

c)

A	B	D	B
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

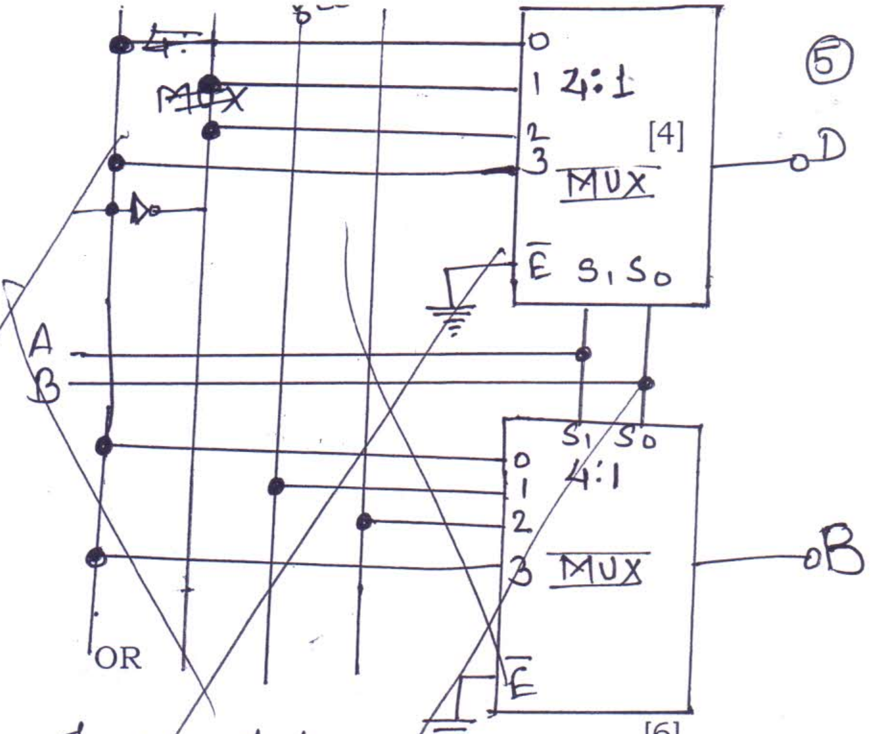
Truth table of Subtractor using two variable.



$D = A\bar{B} + \bar{A}B$

$D = A \oplus B$

$B = \bar{A} \cdot B$



Implementation of full-subtractor using 4:1 multiplexer.

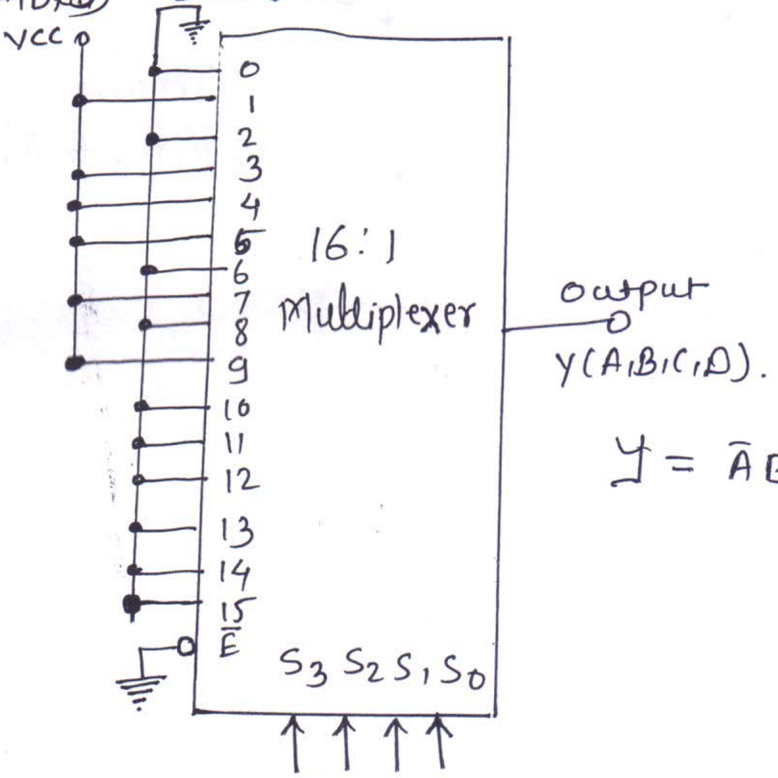
Q.4) A)

$Y = \bar{A}B\bar{C} + A\bar{B}\bar{C}D + \bar{A}\bar{B}D + \bar{A}CD$.

$= \bar{A}B\bar{C}(D+\bar{D}) + A\bar{B}\bar{C}D + \bar{A}\bar{B}D(C+\bar{C}) + \bar{A}CD(B+\bar{B})$

$= \bar{A}B\bar{C}D + \bar{A}B\bar{C}\bar{D} + A\bar{B}\bar{C}D + \bar{A}\bar{B}CD + \bar{A}\bar{B}\bar{C}D + \bar{A}BCD + \bar{A}\bar{B}CD$.

$Y(A,B,C,D) = \Sigma m(1,3,4,5,7,9)$.



$Y = \bar{A}B\bar{C} + A\bar{B}\bar{C}D + \bar{A}\bar{B}D + \bar{A}CD$.

Q.4) b) full-adder using 3-to-8 line decoder. [4]

full adder has 3 i/p & 2 outputs.

A B C	sum	carry
0 0 0	0	0
0 0 1	1	0
0 1 0	1	0
0 1 1	0	1
1 0 0	1	0
1 0 1	0	1
1 1 0	0	1
1 1 1	1	1

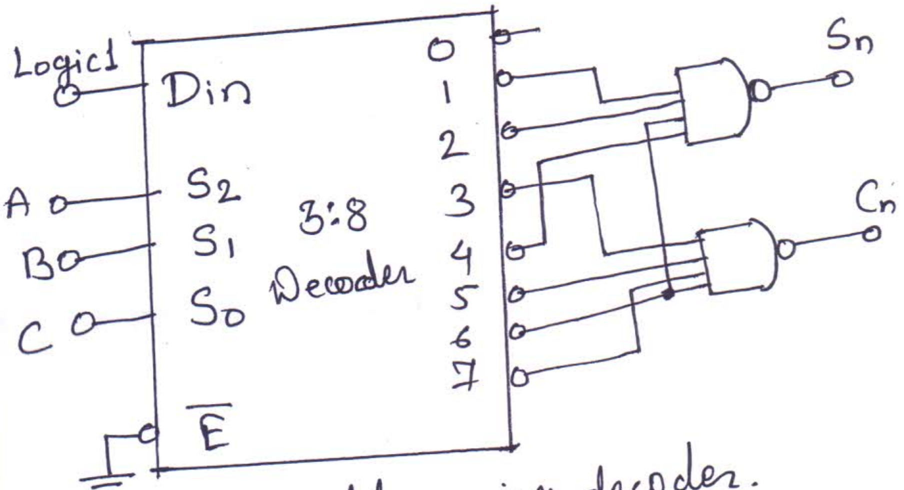


fig: full adder using decoder.

$$S_n(A,B,C) = \Sigma m(1,2,4,7)$$
$$C_n(A,B,C) = \Sigma m(3,5,6).$$

c) Design 4:1 multiplexers using NAND gate only. [4]

4:1 multiplexer.

S_1	S_0	Y
0	0	I_0
0	1	I_1
1	0	I_2
1	1	I_3

$$Y = \bar{S}_1\bar{S}_0 I_0 + \bar{S}_1 S_0 I_1 + S_1\bar{S}_0 I_2 + S_1 S_2 I_3$$
$$\bar{\bar{Y}} = \overline{\overline{\bar{S}_1\bar{S}_0 I_0 + \bar{S}_1 S_0 I_1 + S_1\bar{S}_0 I_2 + S_1 S_2 I_3}}$$
$$= \overline{\overline{\bar{S}_1\bar{S}_0 I_0} \cdot \overline{\bar{S}_1 S_0 I_1} \cdot \overline{S_1\bar{S}_0 I_2} \cdot \overline{S_1 S_2 I_3}}$$

Q. 4) c) Even parity generator.

A	B	C	D	P
0	0	0	0	0
0	0	0	1	1
0	0	1	0	1
0	0	1	1	0
0	1	0	0	1
0	1	0	1	0
0	1	1	0	0
0	1	1	1	1
1	0	0	0	1
1	0	0	1	0
1	0	1	0	0
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	0

CD \ AB	00	01	11	10
00	0	1	0	1
01	1	0	1	0
11	0	1	0	1
10	1	0	1	0

$$P = \bar{A}\bar{B}\bar{C}D + \bar{A}B\bar{C}\bar{D} + \bar{A}\bar{B}C\bar{D} + \bar{A}BCD + AB\bar{C}D + A\bar{B}\bar{C}\bar{D} + ABC\bar{D} + A\bar{B}CD$$

$$= \bar{A}\bar{C}(\bar{B}D + B\bar{D}) + \bar{A}C(\bar{B}\bar{D} + BD) + A\bar{C}(BD + \bar{B}\bar{D}) + AC(B\bar{D} + \bar{B}D)$$

$$= \bar{A}\bar{C}(B \oplus D) + \bar{A}C(B \odot D) + A\bar{C}(B \odot D) + AC(B \oplus D)$$

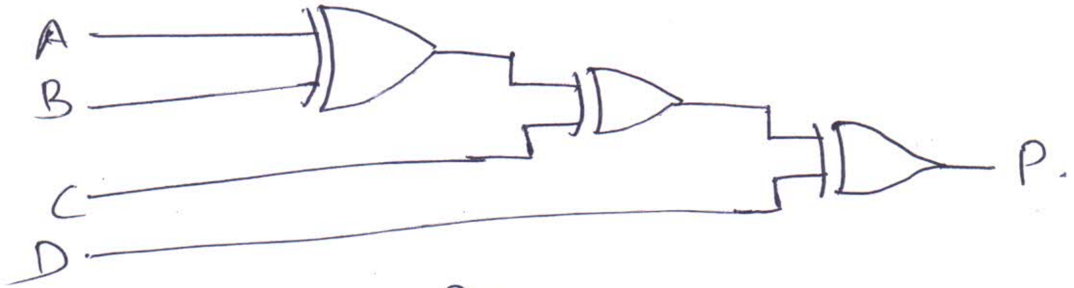
$$= (\bar{A}\bar{C} + AC)(B \oplus D) + (\bar{A}C + A\bar{C})(B \odot D)$$

$$= (A \odot C)(B \oplus D) + (A \oplus C)(B \odot D)$$

$$= (\overline{A \oplus C})(B \oplus D) + (A \oplus C)(\overline{B \oplus D})$$

$$= (A \oplus C) \oplus (B \oplus D)$$

$$\boxed{P = A \oplus B \oplus C \oplus D}$$



Logic Diagram.