

Questions should be —
WRITTEN IN LEGIBLE HANDWRITING IN BLACK INK.
SIGNS, SKETCHES OR FIGURES IF ANY BE DRAWN IN NEAT BLACK INK,
so as to avoid mistakes in the printed question papers.

Duration 3:00. Hours.

Total Marks assigned to the paper 80

Q. No.

Solution.

Marks

N.B.: 1. Any other valid solution can also be considered right if answers are matching/same.

Q-1. ⊖

Ⓐ

$$P.T. \quad ABC + A\bar{B}C + A\bar{B}\bar{C} = A(B+C)$$

$$L.H.S. = ABC + A\bar{B}C + A\bar{B}\bar{C}$$

$$= AC(B+\bar{B}) + A\bar{B}\bar{C} \quad \because B+\bar{B} = 1$$

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

$$\therefore C + B\bar{C} = C + B.$$

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

$$= A(C + B)$$

$$= R.H.S.$$

Ⓑ

$$1. \quad (10110011)_2$$

$$i) \text{ Hexadecimal. } - \quad \underline{1011} \underline{0011} = (B3)_H$$

$$ii) \text{ decimal. } - \quad 1 \times 2^0 + 1 \times 2^1 + 0 + 0 + 1 \times 2^4 + 1 \times 2^5 + 1 \times 2^6$$

$$= 1 + 2 + 16 + 32 + 128$$

$$= \underline{\underline{179}}_{10}$$

Ⓒ

ii) Two's Complement -

$$10110011$$

One's complement,

$$01001100$$

+

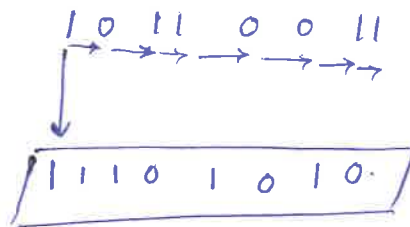
2's com

$$\boxed{01001101}$$

Q. No.

Marks

17) Gray Code -



d)

level triggering.

Edge triggering.

1) Definition

2) waveform

c)

TTL logic family.

CMOS logic family.

1) long term -

2) Power consumption in one single gate in TTL -

10mw.

10nw.

3)

Many components are required

less.

4)

rugged.

delicate
susceptible to electrostatic discharge

Q. No.

(e)

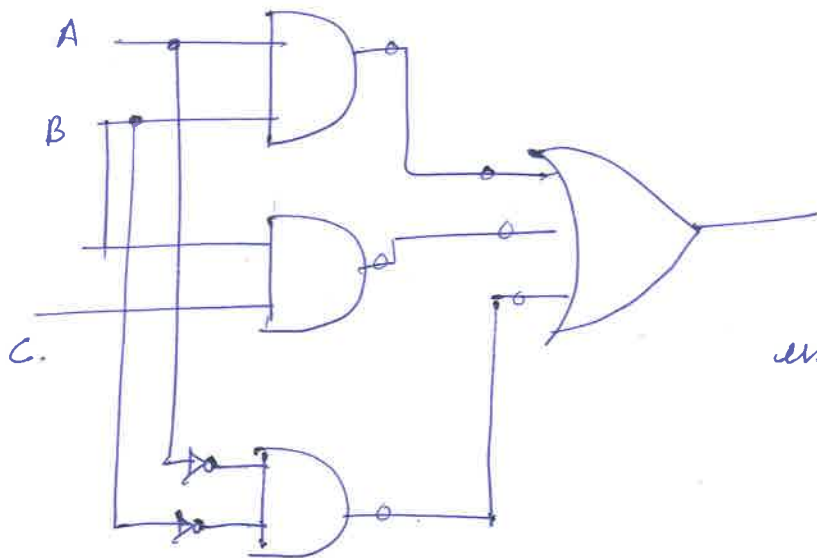
$$\begin{array}{r}
 634_8 \\
 + 152_8 \\
 \hline
 886 \\
 \begin{array}{l}
 -8 \quad -8 \quad \downarrow \\
 \hline
 1 \quad 0 \quad 0 \quad 6
 \end{array} \\
 = (1006)_8.
 \end{array}$$

$$\begin{array}{r}
 A65 \\
 + 777 \\
 \hline
 1065 \\
 \begin{array}{l}
 -8 \quad +16 \quad +16 \quad +16 \\
 \hline
 2 \quad 22 \quad 32 \quad 21 \\
 -8 \quad -8 \quad -7 \\
 \hline
 14 \quad 14 \quad 14
 \end{array} \\
 2EE \\
 = (2EE)_H.
 \end{array}$$

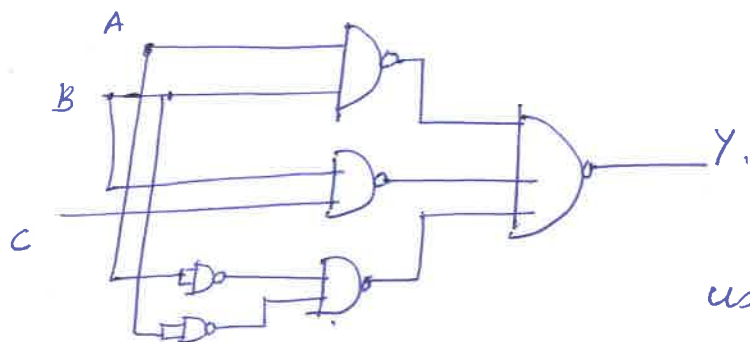
Marks

(f)

$$Y = AB + BC + \overline{A}\overline{B}$$



using basic gates.



using NAND.

Marks

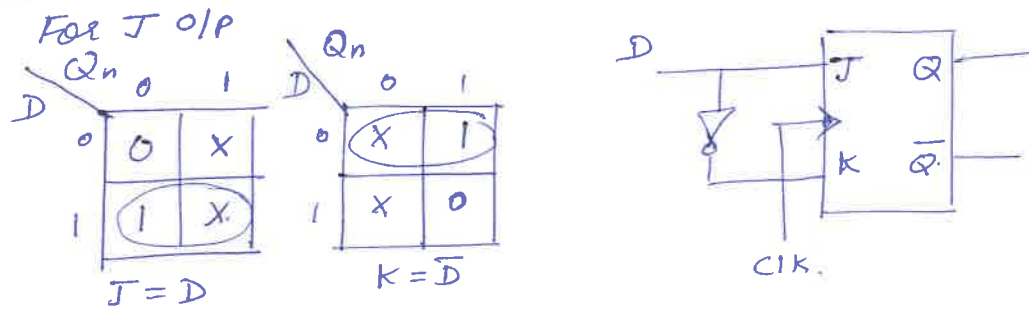
Q. No.
Q-2
A

JK F.F to D F.F.

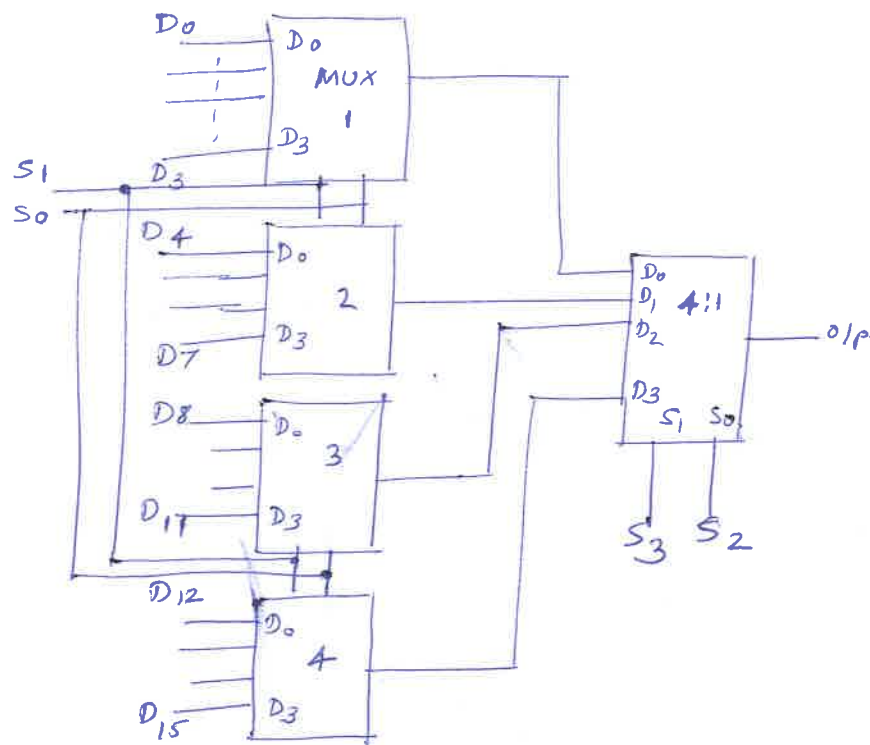
①

D	i/p		o/p	
	Previous state Q_n	Next state Q_{n+1}	J	K
0	0	0	0	X
1	0	1	1	X
0	1	0	X	1
1	1	1	X	0

② K map & simplification



Q-2
B



Q. No.
Q-3-A.

$$Y(A, B, C, D) = \sum m(0, 1, 2, 3, 5, 7, 8, 9, 11, 14.)$$

Solve by Quine-~~W~~usky -

step ① - arrange all minterms according to no of 1's.

Group	Minterm	Binary representation				
No of 1's 0	0	0	0	0	0	✓
	1	0	0	0	1	✓
	2	0	0	1	0	✓
	8	1	0	0	0	✓
	No of 1's 2	3	0	0	1	1
5		0	1	0	1	✓
9		1	0	0	1	✓
No of 1's 3		7	0	1	1	1
	11	1	0	1	1	✓
	14	1	1	1	0	✓

Not
paired. $\overline{A} \overline{B} \overline{C} D$

Q. No.
Step ②

Combinations of minterms in groups of 2.

Marks

Group	Minterm	Binary Representation				
		A	B	C	D	
0	0 - 1	0	0	0	-	✓
	0 - 2	0	0	-	0	✓
	0 - 8	-	0	0	0	✓
1	1 - 3	0	0	-	1	✓
	1 - 5	0	-	0	1	✓
	1 - 9	-	0	0	1	✓
	2 - 3	0	0	1	-	✓
	8 - 9	1	0	0	-	✓
2	3 - 7	0	-	1	1	✓
	3 - 11	-	0	1	1	✓
	5 - 7	0	1	-	1	✓
	9 - 11	1	0	-	1	✓

minterms differ are indicated by dash.

Step ③

Combine the terms into group of four.

Group	Minterm	Binary representation				Prime implicants
		A	B	C	D	
0	0 - 1 - 2 - 3	0	0	-	-	$\overline{A}\overline{B}$ $\overline{B}\overline{C}$
	0 - 1 - 8 - 9	-	0	0	-	
	0 - 2 - 1 - 3	0	0	-	-	
	0 - 8 - 1 - 9	-	0	0	-	
1	1 - 5 - 3 - 7	0	-	-	1	$\overline{A}D$ $\overline{B}D$
	1 - 9 - 3 - 11	-	0	-	1	
	1 - 3 - 5 - 7	0	-	-	1	
	1 - 3 - 9 - 11	-	0	-	1	

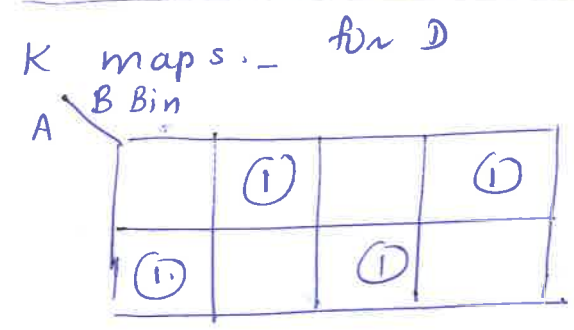
$$\therefore Y(A, B, C, D) = ABC\overline{D} + \overline{A}\overline{B} + \overline{B}\overline{C} + \overline{A}D + \overline{B}D$$

Q. No.
Q-3-B

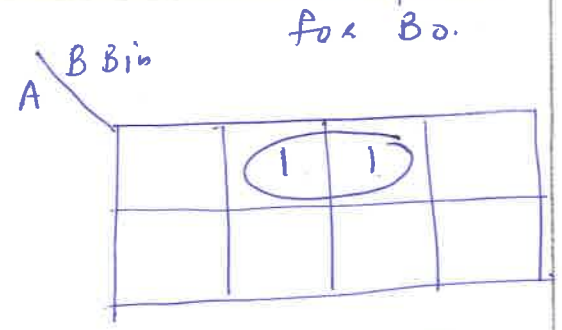
Full subtractor

	i/p			o/p	
	A	B	B_{in}	$(A - B - B_{in})$	B_0
0	0	0	0	0	0
1	0	0	1	1	1
2	0	1	0	1	1
3	0	1	1	0	1
4	1	0	0	1	0
5	1	0	1	0	0
6	1	1	0	0	0
7	1	1	1	1	1

Marks



$$D = \bar{A}\bar{B}B_{in} + \bar{A}B\bar{B}_{in} + A\bar{B}\bar{B}_{in} + AB B_{in}$$



$$B_0 = \bar{A}B_{in} + \bar{A}B + B B_{in}$$

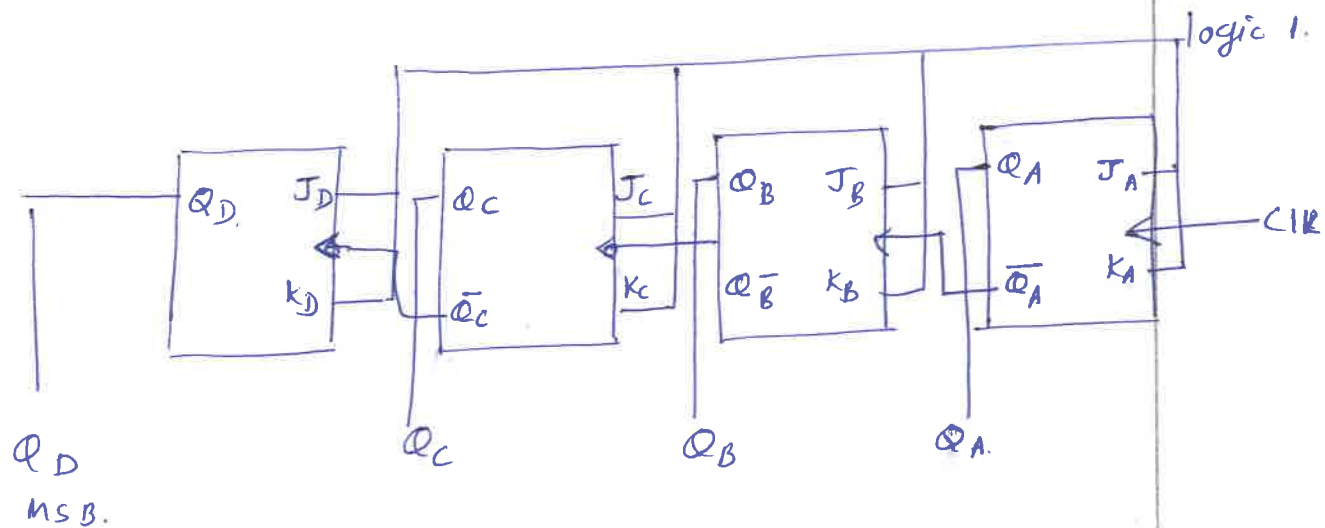
After simplification $D = B_{in} \oplus A \oplus B$

CKT diagram is essential, before simplification or after simplification.

Q. No. Q-4-(A) 4 bit asynchronous down counter

Marks

CLK	Flip Flop o/p				state	Decimal equivalent
	Q _D	Q _C	Q _B	Q _A		
	0	0	0	0	1	0
	1	1	1	1		15
	1	1	1	0		14
	1	1	0	1		13
	1	1	0	0		12
						⋮
	0	0	0	0		0
	1	1	1	1		15



Q. No.
Q-4-B

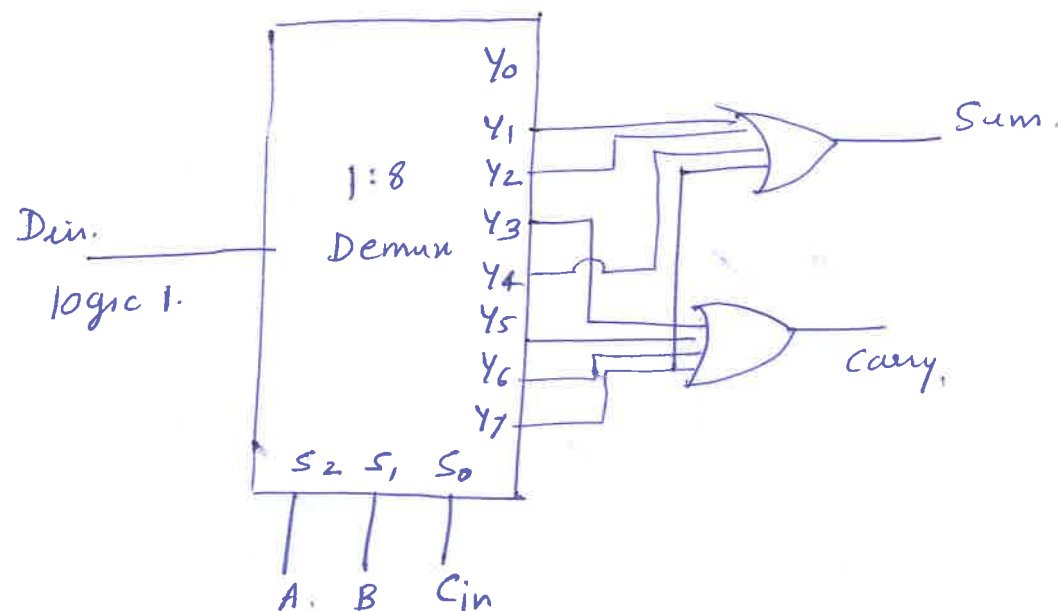
Full adder using demultiplexer.

Marks

	A	B	Cin	Sum	Carry
0	0	0	0	0	0
1	0	0	1	1	0
2	0	1	0	1	0
3	0	1	1	0	1
4	1	0	0	1	0
5	1	0	1	0	1
6	1	1	0	0	1
7	1	1	1	1	1

$$\text{Sum} = \sum m(1, 2, 4, 7) \Rightarrow \text{ORed to get o/p}$$

$$\text{Carry} = \sum m(3, 5, 6, 7) \Rightarrow \text{ORed to get o/p}$$



Q-5-(A)

3 bit-binary up-down counter -
with direction control M. -
Synchronous - JK F.F.

M	state			F.F i/p					
	Q ₂	Q ₁	Q ₀	J ₀	K ₀	J ₁	K ₁	J ₂	K ₂
0	0	0	0	1	X	0	X	0	X
1	0	0	1	X	1	1	X	0	X
2	0	1	0	1	X	X	0	0	X
3	0	1	1	X	1	X	1	1	X
4	1	0	0	1	X	0	X	X	0
5	1	0	1	X	1	1	X	X	0
6	1	1	0	1	X	X	0	X	0
7	1	1	1	1	X	X	1	X	1
0	0	0	0	1	X	0	X	1	X
1	0	0	1	X	1	X	0	X	0
2	0	1	0	1	X	X	0	X	0
3	0	1	1	X	1	0	X	X	1
4	1	0	0	1	X	0	X	0	X
5	1	0	1	X	1	0	X	X	1
6	1	1	0	1	X	X	0	X	0
7	1	1	1	1	X	X	1	X	1
0	0	0	0	1	X	0	X	1	X
1	0	0	1	X	1	0	X	0	X
2	0	1	0	1	X	X	0	0	X
3	0	1	1	X	1	0	0	0	X
4	1	0	0	1	X	0	X	0	X
5	1	0	1	X	1	0	X	X	1
6	1	1	0	1	X	X	0	X	0
7	1	1	1	1	X	X	1	X	1
0	0	0	0	1	X	0	X	1	X

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N.B. :

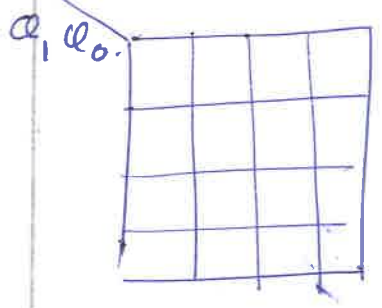
By K maps -

$$J_0 = K_0 = 1$$

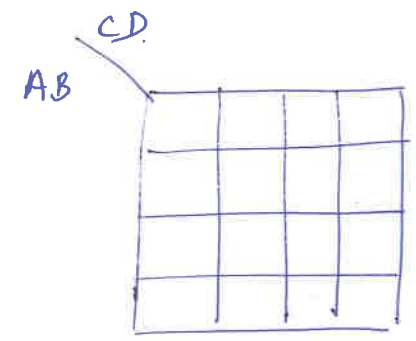
$$J_1 = K_1 = Q_0 \bar{M} + \bar{Q}_0 M.$$

$$J_2 = K_2 = \bar{M} Q_1 Q_0 + M \bar{Q}_1 \bar{Q}_0$$

$M Q_2$



Q - 5 - B.



Simplification using don't care condition.

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