Q.P. Code 35474

Solution

Q.1

(a) DeMorgan's theorems

1) $\overline{AB} = \bar{A} + \bar{B}$

Proof:

A (1)	B (2)	$\overline{AB}$ (3)	$\bar{A}$ (4)	$\bar{B}$ (5)	$\bar{A}+\bar{B}$ (6)
0	0	1	1	1	1
0	1	1	1	0	1
1	0	1	0	1	1
1	1	0	0	0	0

column (3) = column (6)

$\overline{AB} = \bar{A} + \bar{B}$ Hence proved.

2) $\overline{A+B} = \bar{A} \cdot \bar{B}$

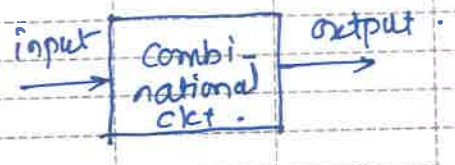
A (1)	B (2)	$\overline{A+B}$ (3)	$\bar{A}$ (4)	$\bar{B}$ (5)	$\bar{A} \cdot \bar{B}$ (6)
0	0	1	1	1	1
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	0

i.e. column (3) = column (6)

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

(b) Compare Combinational and sequential logic ckts.

Combinational

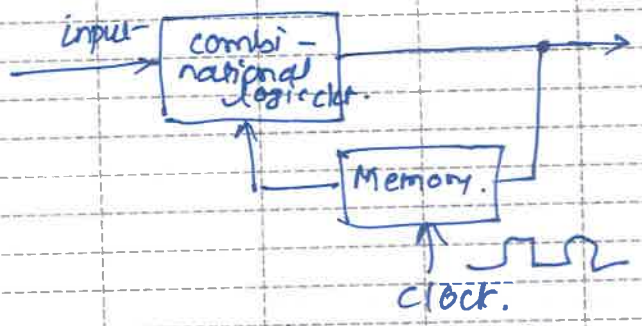


1) The output depends on present input.

2) No need of clock.

3) No need of memory

Sequential.



1) o/p depends on present inputs and past outputs.

2) clock required.

3) Memory required.

Q.1 (c) Define

Propagation delay: The output of a logic gate does not change its state instantaneously in response to the change in the state of its input. There is a time delay in the two events. This time delay is known as the propagation delay.

Thus propagation delay is defined as the time delay between the instants of application of the input and the instant of occurrence of the corresponding output.

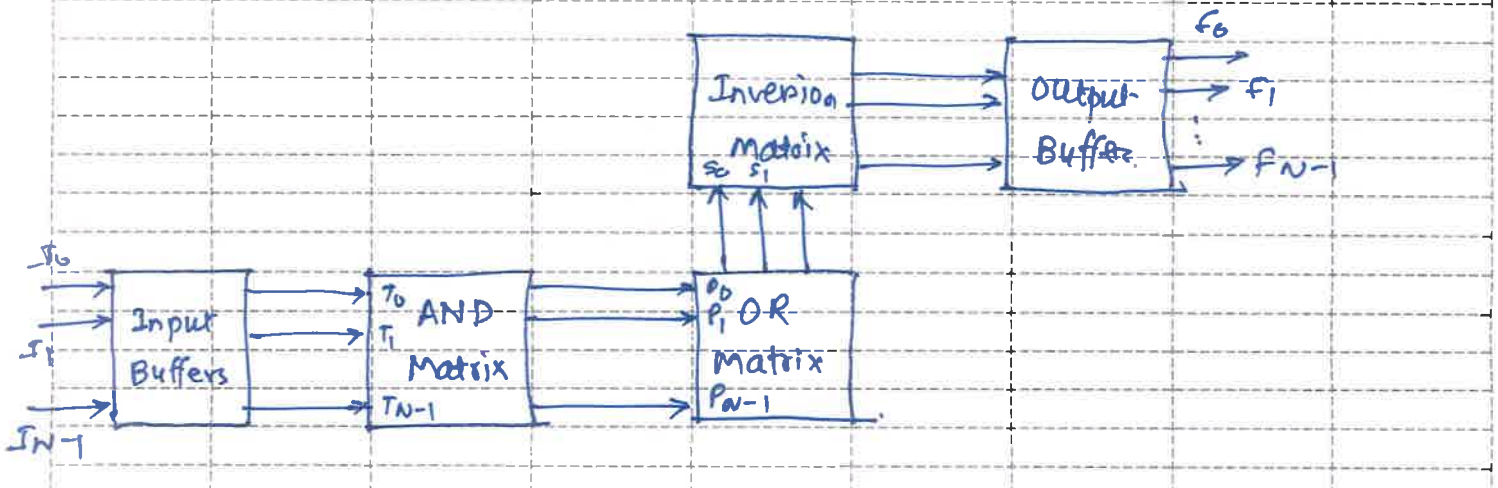
Power Dissipation: Due to applied voltage and the flow of the resultant current, some power is dissipated in the form of heat.

$$P_D = V_{cc} \cdot I_{cc}$$

Fan out: Fan out is defined as the maximum number of ~~output~~ devices a gate can drive without change in its output voltage.

Fan in: Fan in is defined as the number of inputs a Gate has.

(d) **Programmable Logic Array:**



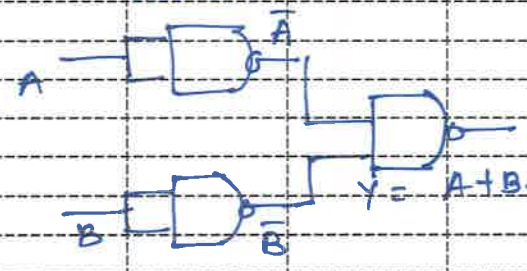
Q.2(a)

NAND

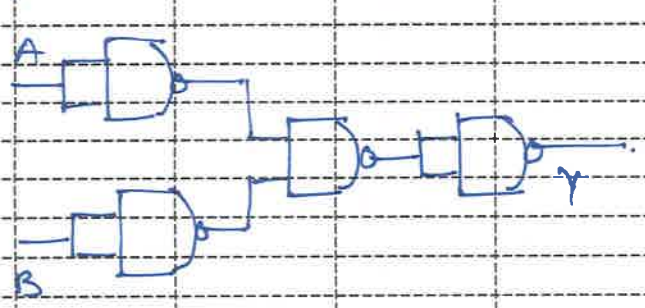
1) NOT Gate.

2) AND

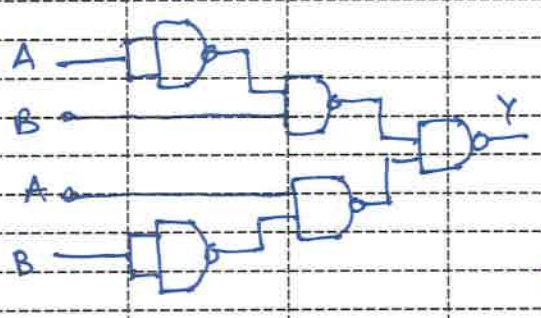
3) OR Gate



4) NOR:

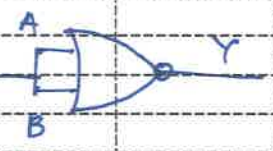


5) Ex-OR

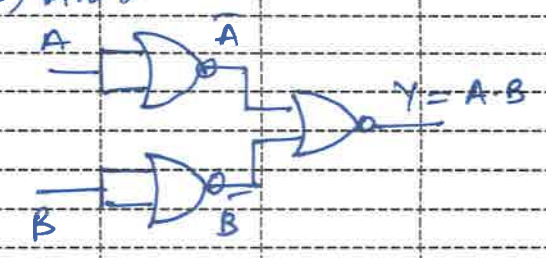


NOR.

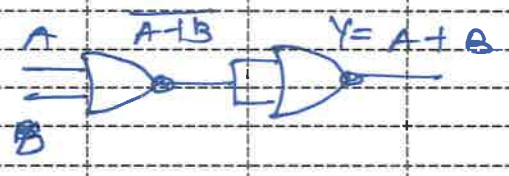
1) NOT



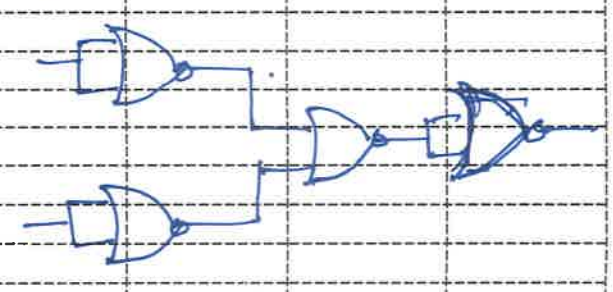
2) AND



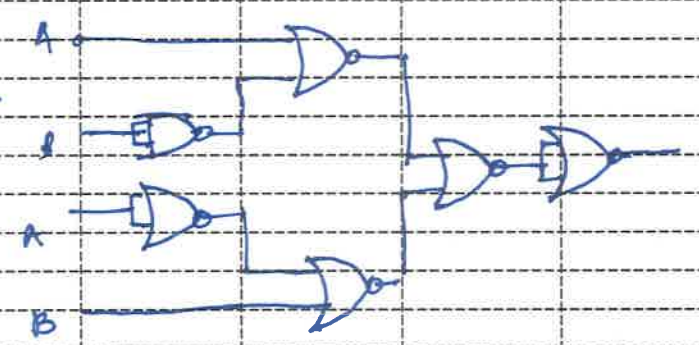
3) OR



4) NAND.



5) Ex-OR



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Q.2(b) Two bit digital comparator

Sr.	Inputs A_1	A_0	B_1	B_0	Output $A<B$	$A=B$	$A>B$
0	0	0	0	0	0	1	0
1	0	0	0	1	1	0	0
2	0	0	1	0	1	0	0
3	0	0	1	1	1	0	0
4	0	1	0	0	0	0	1
5	0	1	0	1	0	1	0
6	0	1	1	0	1	0	0
7	0	1	1	1	1	0	0
8	1	0	0	0	0	0	1
9	1	0	0	1	0	0	1
10	1	0	1	0	0	1	0
11	1	0	1	1	1	0	0
12	1	1	0	0	0	0	1
13	1	1	0	1	0	0	1
14	1	1	1	0	0	0	1
15	1	1	1	1	0	1	0

K-Map for $A<B$

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

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

K-Map for $A=B$

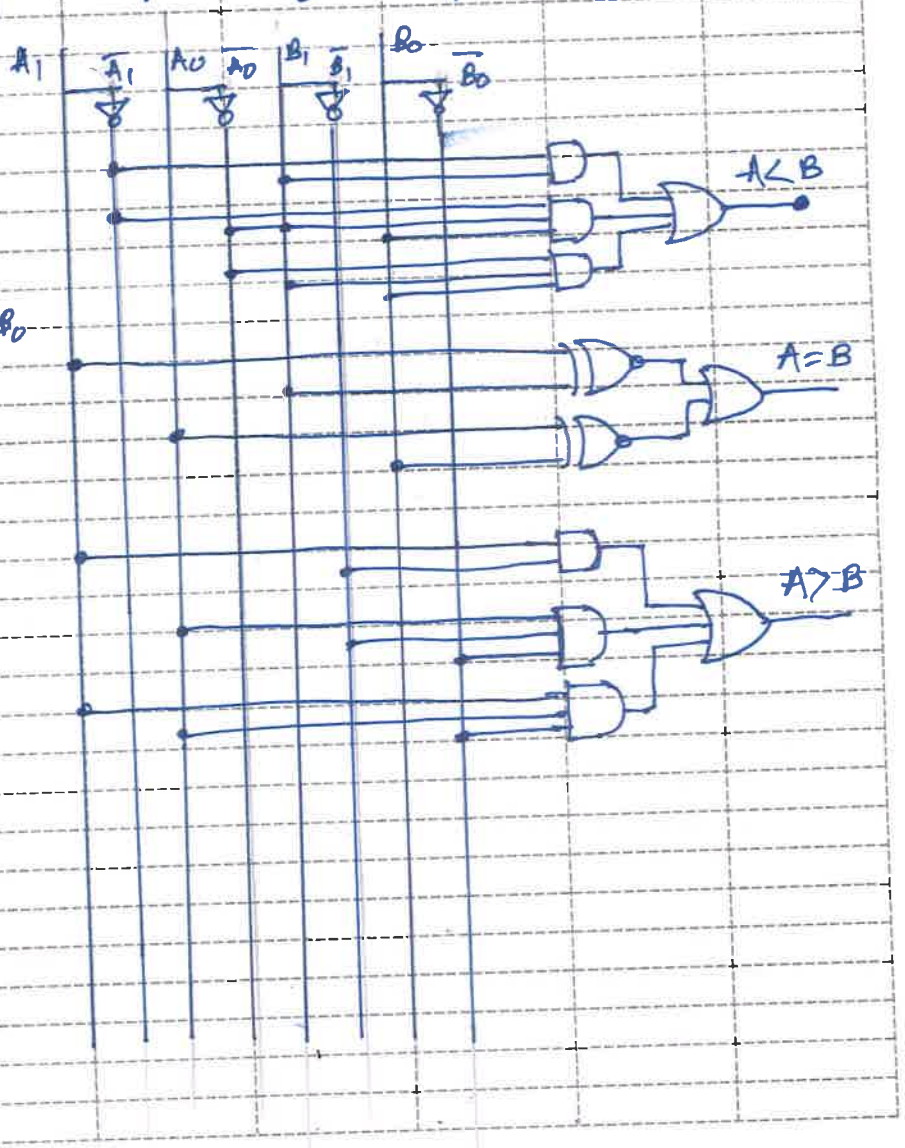
B_1B_0 \ A_1A_0	00	01	11	10
00	1			
01		1		
11			1	
10				1

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

K-Map for $A>B$

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

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



05

Q.3 (a) $Y_1 = (A+C)(A+D)(B+C)(B+D)$

$= (AA+AD+AC+CD)(B+C)(B+D)$

$= (A+AD+AC+CD)(B+C)(B+D)$

$= [A(1+C+D)+CD](B+C)(B+D)$

$= [A+CD](B+C)(B+D)$

$= [A+CD](BB+BD+BC+CD)$

$= [A+CD][B(1+C+D)+CD]$

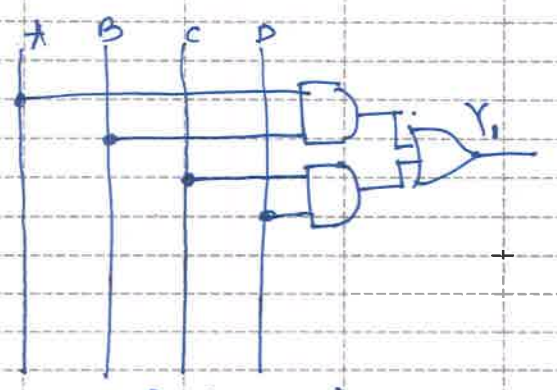
$= [A+CD)[B+CD]$

$= AB+ACD+BCD+CD\cdot CD$

$= AB+ACD+BCD+CD$

$= AB+CD(1+A+B)$

$= AB+CD$

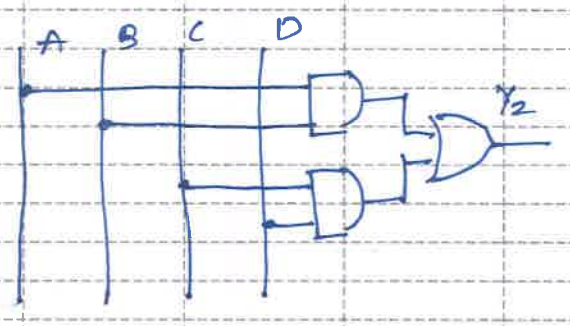


$Y_2 = (AB+C)(AB+D)$

$= (AB+ABD+ABC+CD)$

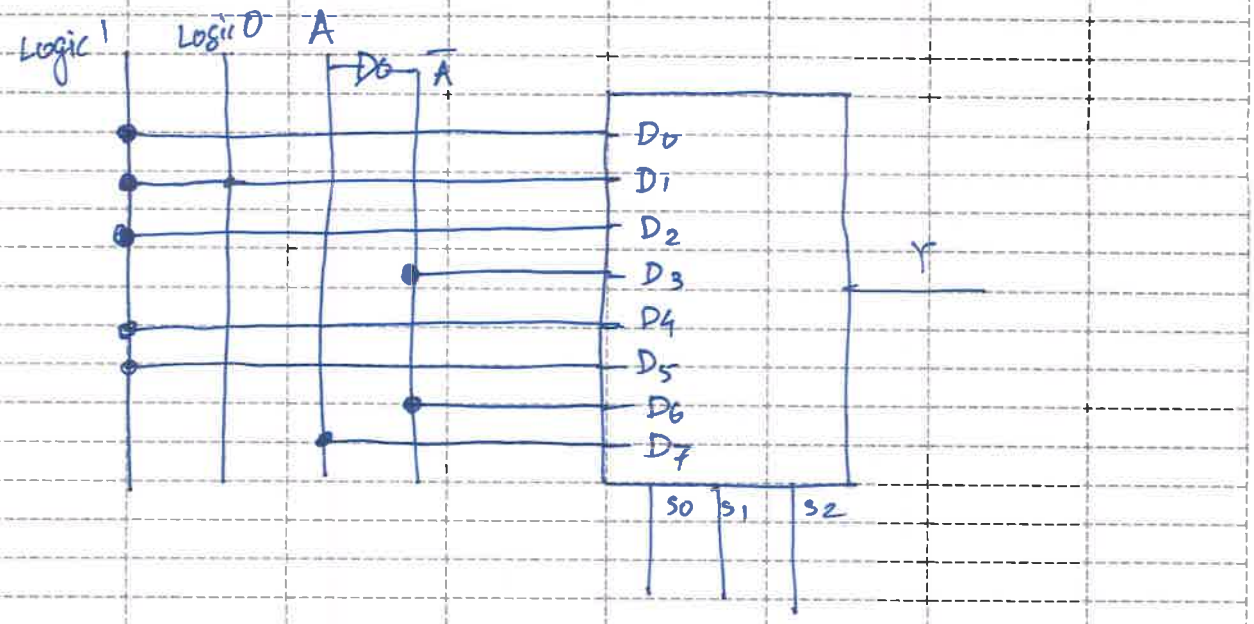
$= AB(1+C+D)+CD$

$= AB+CD$



Q.3(b) $f(A,B,C,D) = \sum m(0,1,2,3,4,5,6,8,9,10,12,13,15)$

$\bar{A}$	0	1	2	3	4	5	6	7
A	8	9	10	11	12	13	14	15
Input-	1	1	1	$\bar{A}$	1	1	$\bar{A}$	A



Q.5 a) $f(A,B,C,D) = \sum m(1,3,7,9,10,11,13,15)$

Step 1	Group	Minterm	Binary A	B	C	D
	0	1	0	0	0	1
		3	0	0	1	1
	1	9	1	0	0	1
		10	1	0	1	0
		7	0	1	1	1
	2	11	1	0	1	1
		13	1	1	0	1
	3	15	1	1	1	1

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Step II

Group	Pair of Minterms	Binary A	B	C	D	Prime Implicants.
0	1 - 3	0	0	—	1	✓
	1 - 9	—	0	0	1	✓
1	3 - 7	0	—	1	1	✓
	3 - 11	—	0	1	1	✓
	9 - 11	1	0	—	1	✓
	9 - 13	1	—	0	1	✓
	10 - 11	1	0	1	—	$A\bar{B}C$
2	7 - 15	—	1	1	1	✓
	11 - 15	1	—	1	1	✓
	13 - 15	1	1	—	1	✓

Step III

Group	Minterms	Binary A	B	C	D	
0	1, 3, 9, 11	—	0	—	1	$\bar{B}D$
1	3, 7, 11, 15	—	—	1	1	CD
	9, 11, 13, 15	1	—	—	1	AD

Table of Prime Implicants.

Prime Implicants.	Decimal numbers.	1	3	7	9	10	11	13	15
$A\bar{B}C$	10, 11					(X)	X		
$\bar{B}D$	1, 3, 9, 11	(X)	X		X		X		
CD	3, 7, 11, 15		X	(X)			X		X
AD	9, 11, 13, 15				X		X	(X)	X

$\therefore f(A, B, C, D) = A\bar{B}C + \bar{B}D + CD + AD$

Q.5(b) JK FF to D ff. Conversion.

Truth table

Inputs			Outputs.	
D	Q_n	Q_{n+1}	J_n	K_n
0	0	0	0	x
1	0	1	1	x
0	1	0	x	1
1	1	1	x	0

K-Map for J

Q_n \ D	0	1
0		1
1	x	x

$J = D$

K-Map for K

Q_n \ D	0	1
0	x	x
1	1	

$K = \bar{D}$

T ff - D FF Conversion

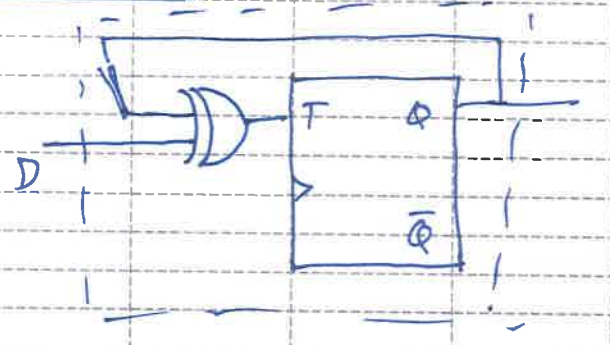
Inputs			Output
D	Q_n	Q_{n+1}	T
0	0	0	0
1	0	1	1
0	1	0	1
1	1	1	0

K-Map for T.

Q_n \ D	0	1
0		1
1	1	

$T = \bar{D}Q_n + D\bar{Q}_n$

$= D \oplus Q_n$



Q. 6(a)