National University of Computer and Emerging Sciences, Lahore Campus

Course:	Digital Logic Design	Course Code:	EE-227
Program:	BS (Computer Science)	Semester:	Spring 2021
Duration:	20 Minutes	Total Marks:	20
Paper Date:	14-June-21	Weight	3 %
Section:	2F	Page(s):	3
Exam:	Quiz 1	Reg. No.	

Instruction/Notes: Calculators are strictly not allowed in all exams
Plagiarism will be dealt seriously causing an F in course

Solution

[10M]

Question 01:

Characteristic table of NP Flip-Flop is given below:

a) **Write the Characteristic equation of NP Flip-Flop. Show your working to get credit.**
b) **Fill in the excitation table of NP Flip Flop.**
c) **Draw its circuit.**

Characteristic Table of NP Flip-Flop

N	P	Q(t+1)
0	0	0
0	1	Q(t)
1	0	Q(t)'
1	1	1

Excitation Table of NP Flip-Flop

Q(t)	Q(t+1)	N	P
0	0	0	X
0	1	1	X
1	0	X	0
1	1	X	1

Characteristic Equation of NP Flip-Flop:

Q(t+1) = $\bar{Q}N + QP$

Circuit Diagram of NP Flipflop

Draw yourself

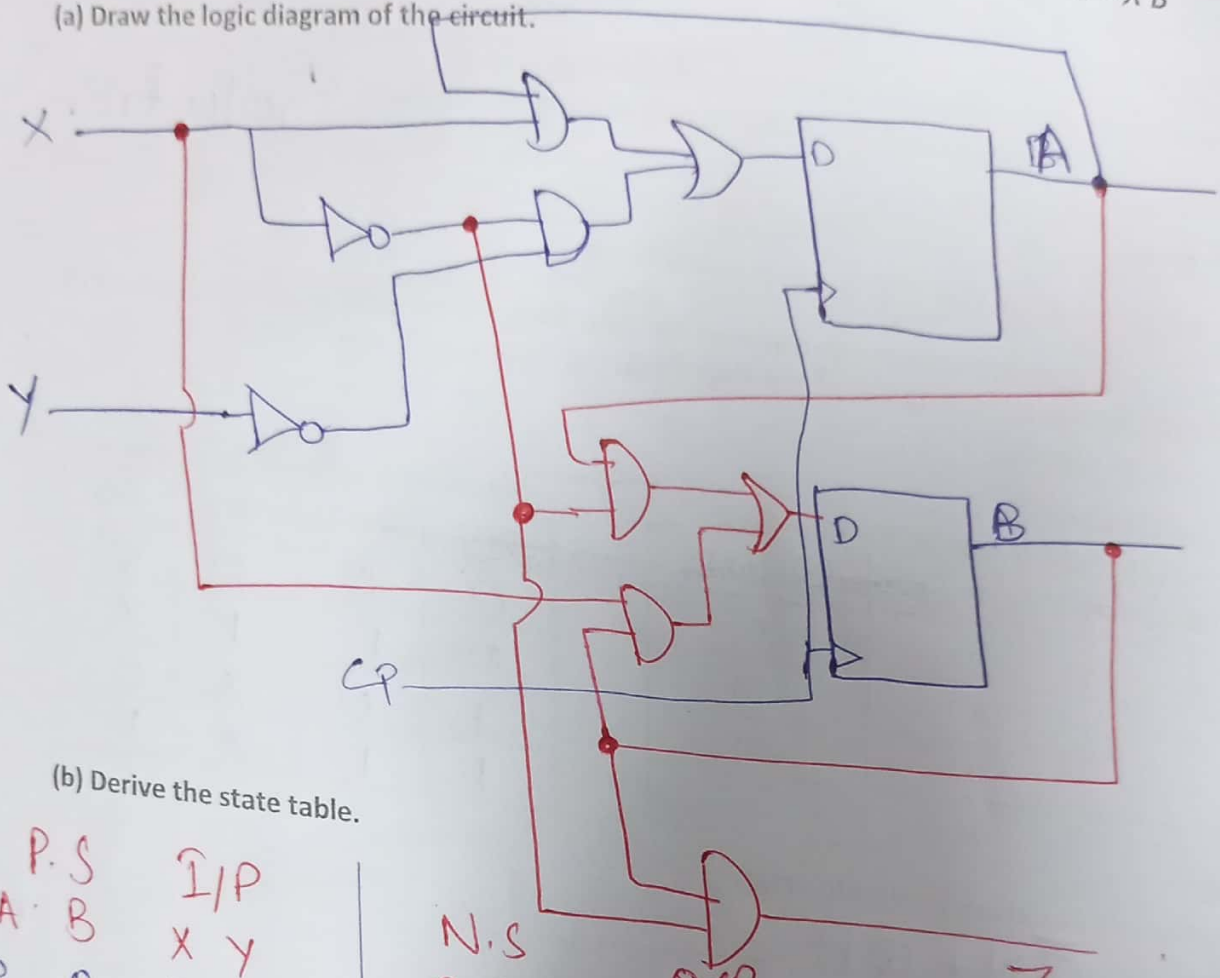
Question 02:

[3+3+3

A sequential circuit with two *D* flip-flops *A* and *B*, two inputs *X* and *Y*, and one output *Z* is specified by the following input equations:

$DA = XA + X'Y'$, $DB = XB + X'A$, $Z = X'B$

(a) Draw the logic diagram of the circuit.



(b) Derive the state table.

P.S A	P.S B	I/P X	I/P Y	N.S A	N.S B	O/P Z
0	0	0	0	1	0	0
0	0	0	1	0	0	0
0	0	1	0	0	0	0
0	0	1	1	0	0	0
0	1	0	0	1	0	0
0	1	0	1	0	0	1
0	1	1	0	0	1	1
0	1	1	1	0	1	0
1	0	0	0	1	1	0
1	0	0	1	0	1	0
1	0	1	0	1	0	0
1	0	1	1	1	0	0
1	1	0	0	1	1	1
1	1	0	1	0	1	1
1	1	1	0	1	1	0
1	1	1	1	1	1	0

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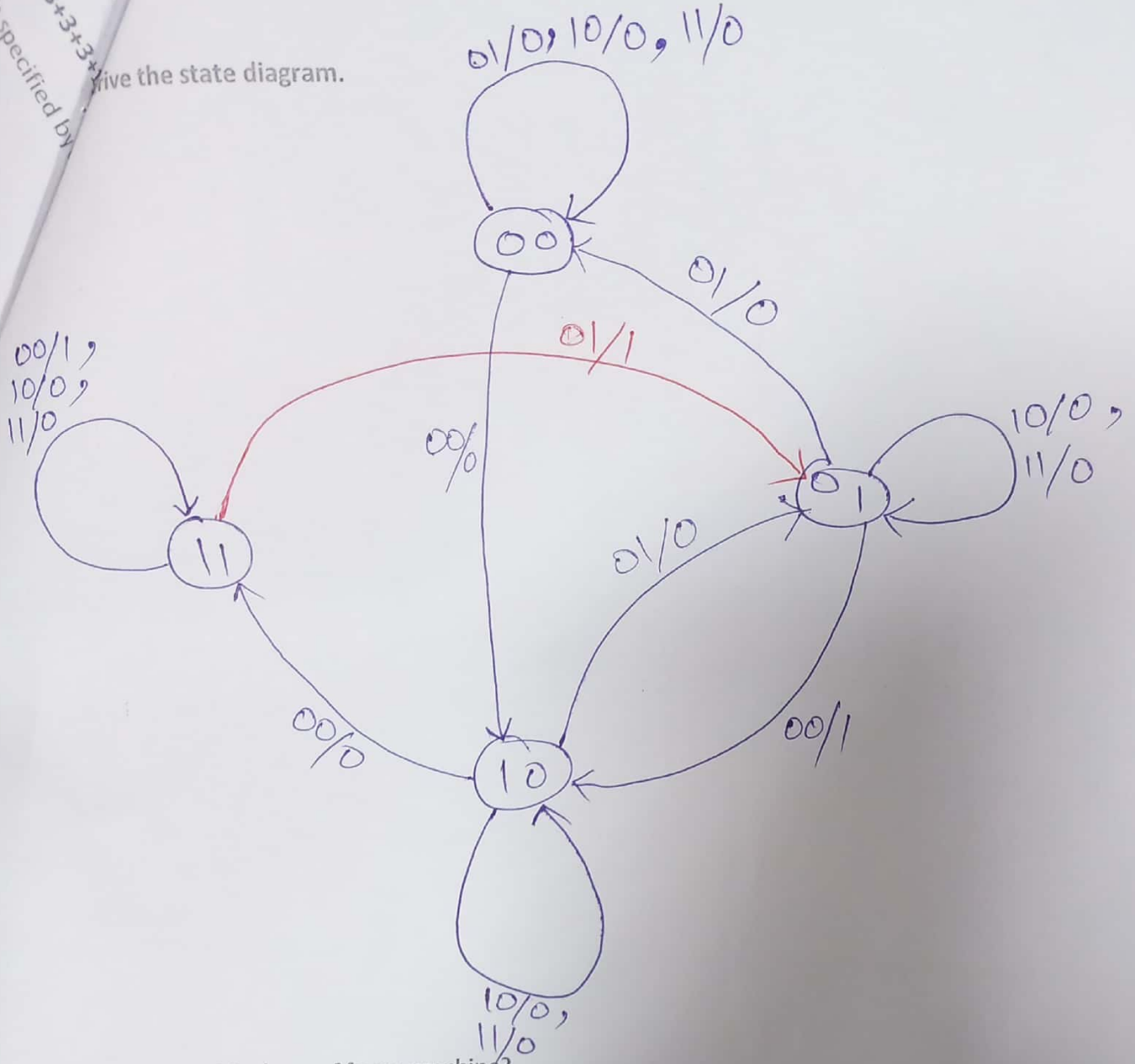
is specified by

ive the state diagram.



(d) Is this a Mealy or a Moore machine?

Mealay - (output is dependant on Present state as well as input)

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Solution

[10M]

Question 01:

Characteristic table of L-M Flip Flop is given below. Find its characteristic equation and draw the circuit diagram.

a) **Write the Characteristic equation of LM Flip-Flop. Show your working to get credit.**
b) **Fill in the excitation table of LM Flip Flop.**
c) **Draw its circuit.**

Characteristic Table of NP Flip-Flop

L	M	Q(t+1)
0	0	Q'(t)
0	1	1
1	0	Q(t)
1	1	0

Excitation Table of LM Flip-Flop

Q(t)	Q(t+1)	L	M
0	0	1	X
0	1	0	X
1	0	X	X
1	1	X	X

Characteristic Equation of LM Flip-Flop:

$Q(t+1) = \bar{Q}\bar{L} + \bar{L}M + Q\bar{L}\bar{M}$

Circuit Diagram of LM Flipflop

Draw yourself

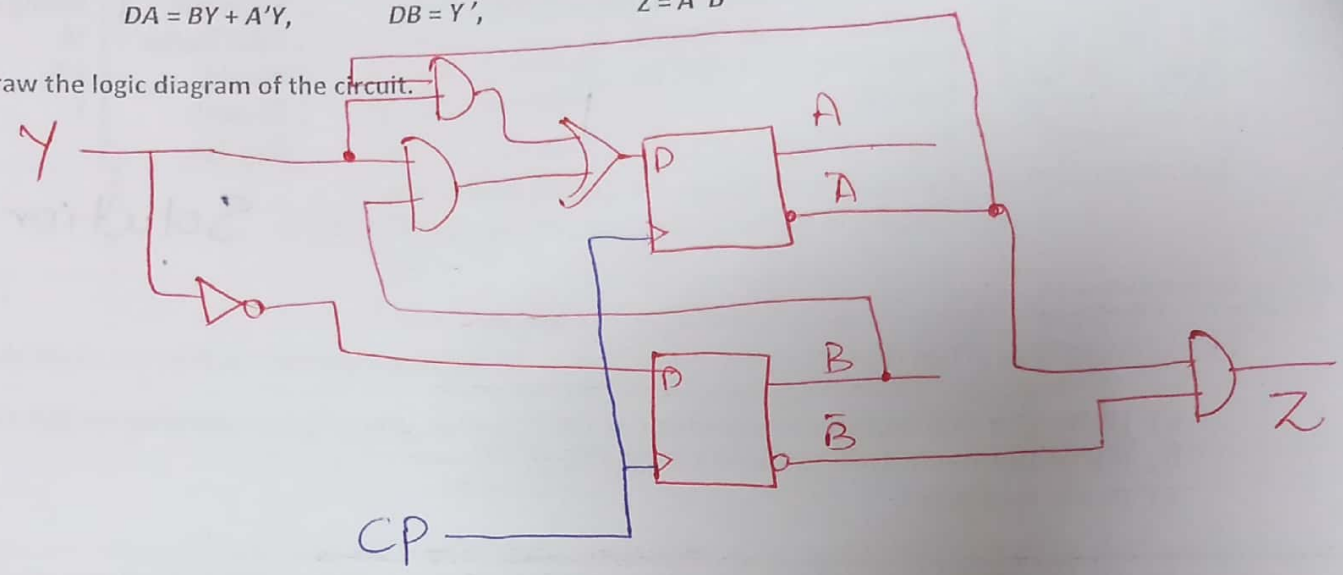
[3+3+3+1]

Question 02:

A sequential circuit with two *D* flip- flops *A* and *B*, one input *Y*, and one output *Z* is specified by the following input equations:

$DA = BY + A'Y$, $DB = Y'$, $Z = A'B'$

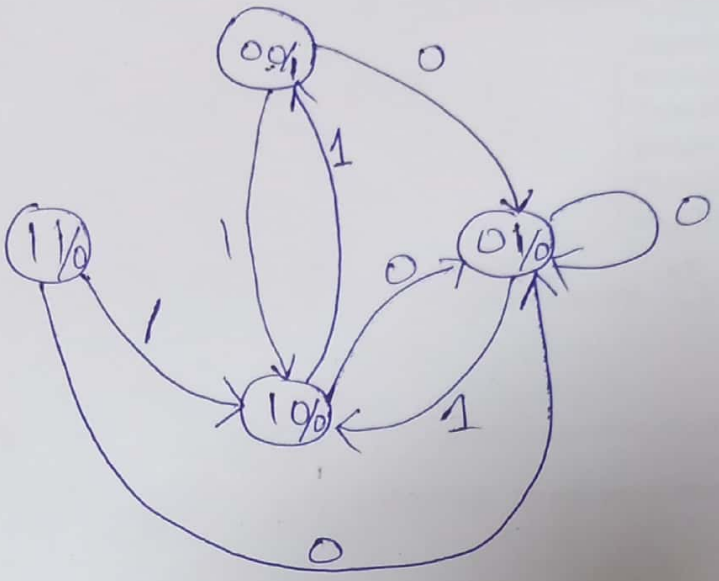
(a) Draw the logic diagram of the circuit.



(b) Derive the state table.

P.S A	P.S B	I/P Y	N.S A	N.S B	output Z
0	0	0	0	1	1
0	0	1	1	0	1
0	1	0	0	1	0
0	1	1	1	0	0
1	0	0	0	1	0
1	0	1	0	0	0
1	1	0	0	1	0
1	1	1	1	0	0

(c) Derive the state diagram.



(d) Is this a Mealy or a Moore machine?

Moore machine

(output is dependent on present state)

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Course:	Digital Logic Design	Course Code:	EE-227
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Section:	2F	Page(s):	2
Exam:	Quiz 2	Roll No.	

Instruction/Notes: Calculators are strictly not allowed in all exams
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Question 01: [5 M]

Simplify following combinational circuits using Boolean algebra identities and rules.
Note: Show all steps of simplification and mention which the laws used for simplification in each step.

$AB'C + A'BC + A'B'C$

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

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

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

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

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

Question 02: [10 M]

Optimize the following functions into (1) sum-of-products and (2) product-of-sums forms:

$F(A, B, C, D) = (A' + B' + D')(A + B' + C')(A' + B + D')(B + C' + D')$

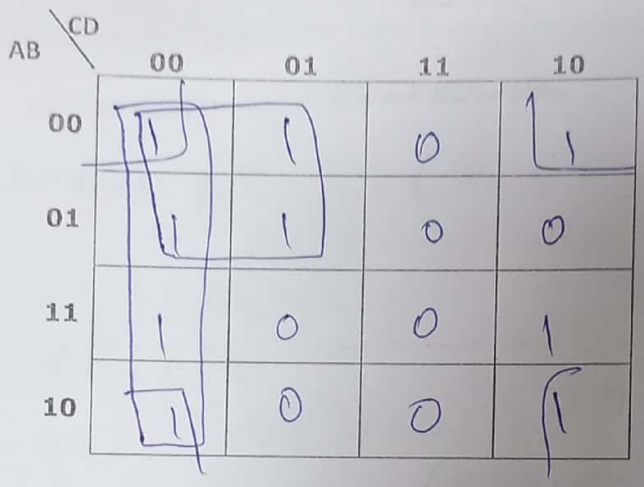
(a) Write the above function in

Sum of Product (SOP)= $\Sigma m(0, 1, 2, 4, 5, 8, 10, 12, 14)$

Product of Sum (POS)= $\Pi M(3, 6, 7, 9, 11, 13, 15)$

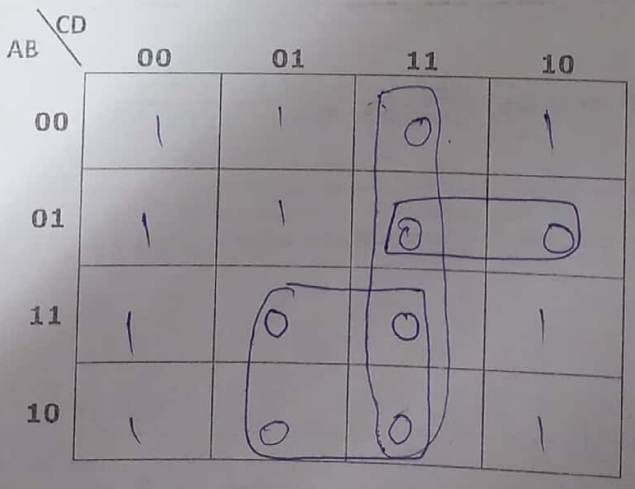
(b) Use only **given K-Maps** to simplify (optimize) the function into:

(i) Sum of Product (SOP) form



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

(ii) Product of Sum (POS) form



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

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Question 01: [5 M]

Simplify following combinational circuits using Boolean algebra identities and rules.
Note: Show all steps of simplification and mention which the laws used for simplification in each step.

$AB'C(BD + CDE) + AC'$

$= A\bar{B}BCD + A\bar{B}CDE + A\bar{C}$ $\quad \because B.\bar{B} = 0$

$= 0 + A(\bar{B}CDE + \bar{C})$ $\quad \because x + \bar{x}y = x + y$

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

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

[10 M]

Question 02:

Optimize the following functions into (1) sum-of-products and (2) product-of-sums forms:

$F(A, B, C, D) = \sum m\,(2, 3, 5, 7, 8, 10, 12, 13)$

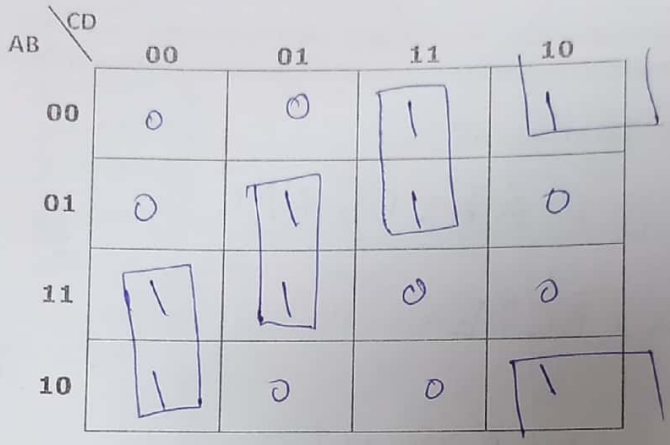
(a) Write the above function in

Sum of Product (SOP)= $(\bar{A}\bar{B}CD + \bar{A}\bar{B}CD + \bar{A}B\bar{C}D + \bar{A}BCD + A\bar{B}\bar{C}\bar{D} + A\bar{B}C\bar{D} + AB\bar{C}\bar{D} + ABC\bar{D})$

Product of Sum (POS)= $(A+B+\bar{C}+D)\cdot(A+B+\bar{C}+\bar{D})\cdot(A+\bar{B}+C+\bar{D})\cdot(A+\bar{B}+\bar{C}+\bar{D})\cdot(\bar{A}+B+C+D)\cdot(\bar{A}+B+\bar{C}+D)\cdot(\bar{A}+\bar{B}+C+D)\cdot(\bar{A}+\bar{B}+C+\bar{D})$

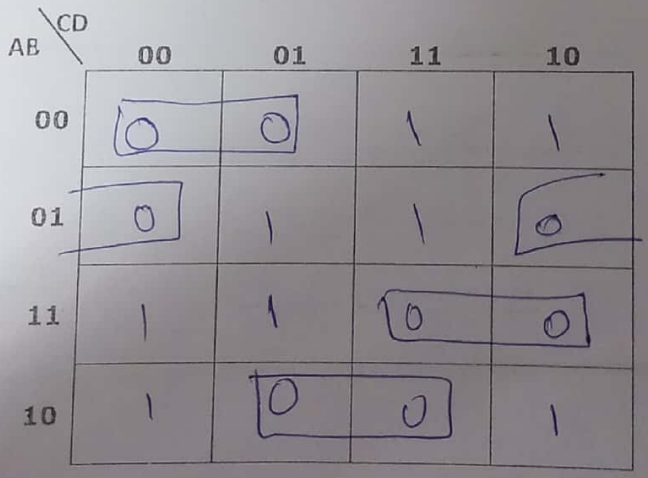
(b) Use only **given K-Maps** to simplify (optimize) the function into:

(i) Sum of Product (SOP) form



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

(ii) Product of Sum (POS) form



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

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Section:	2F	Page(s):	2
Exam:	Quiz 3	Roll No.	

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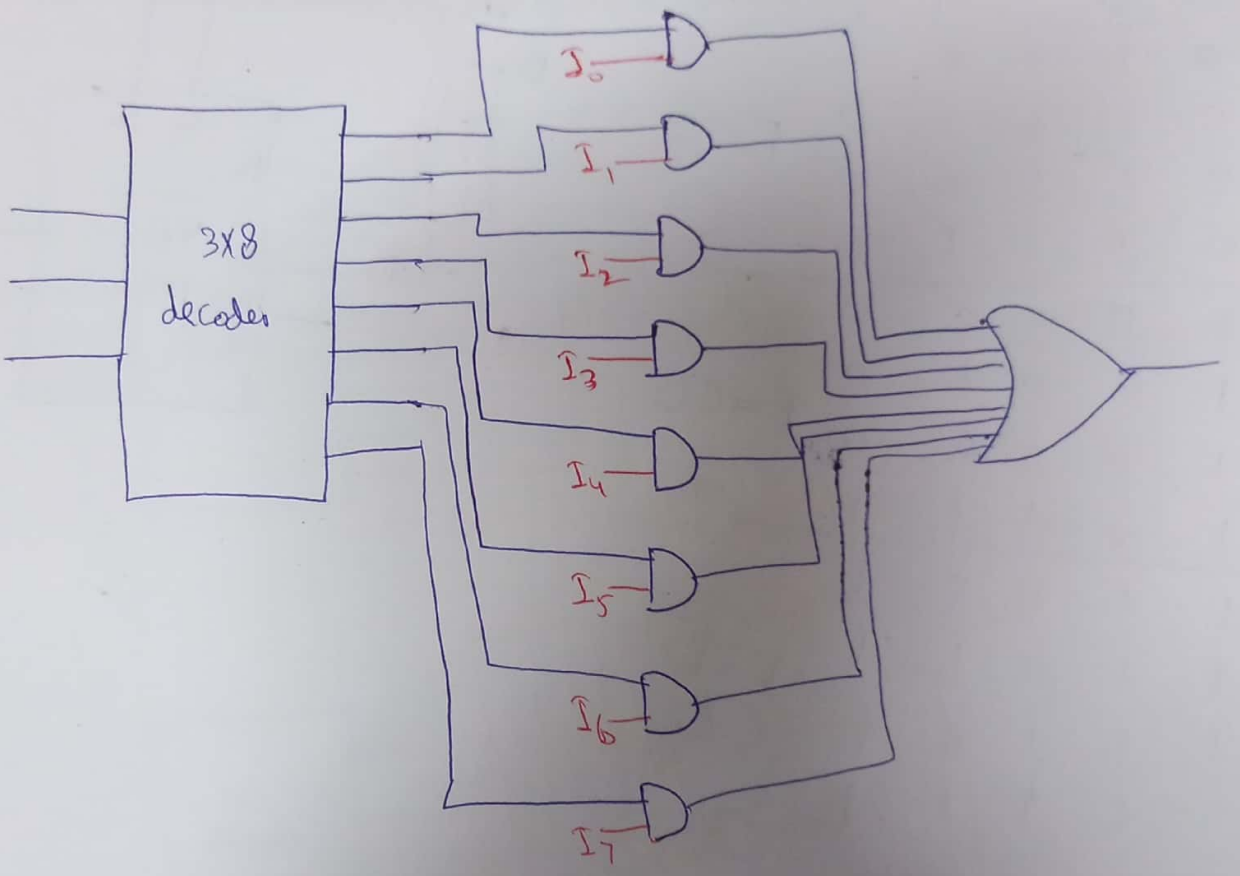
Question 01: **[5 M]**

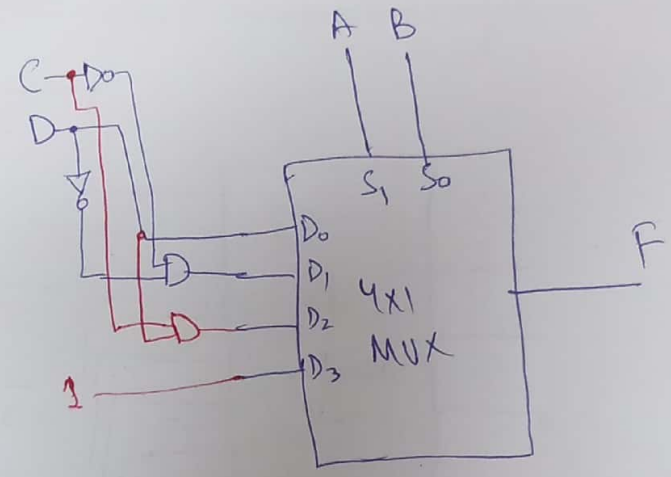
Design an 8–to–1-line multiplexer using a 3–to–8-line decoder and an 8X2 AND-OR.



Question 02: [5M]

Implement the Boolean function $F(A, B, C, D) = \sum m(1, 3, 4, 11, 12, 13, 14, 15)$ with a 4–to–1-line multiplexer and external gates. Connect inputs A and B to the selection lines. The input requirements for the four data lines will be a function of the variables C and D. The values of these variables are obtained by expressing F as a function of C and D for each of the four cases when AB = 00, 01, 10 and 11. These functions must be implemented with external gates.

A	B	C	D	F	
0	0	0	0	0	
0	0	0	1	1	$F = D$
0	0	1	0	0	
0	0	1	1	1	
0	1	0	0	1	
0	1	0	1	0	$F = C\bar{D}$
0	1	1	0	0	
0	1	1	1	0	
1	0	0	0	0	
1	0	0	1	0	$F = CD$
1	0	1	0	0	
1	0	1	1	1	
1	1	0	0	1	
1	1	0	1	1	$F = 1$
1	1	1	0	1	
1	1	1	1	1	



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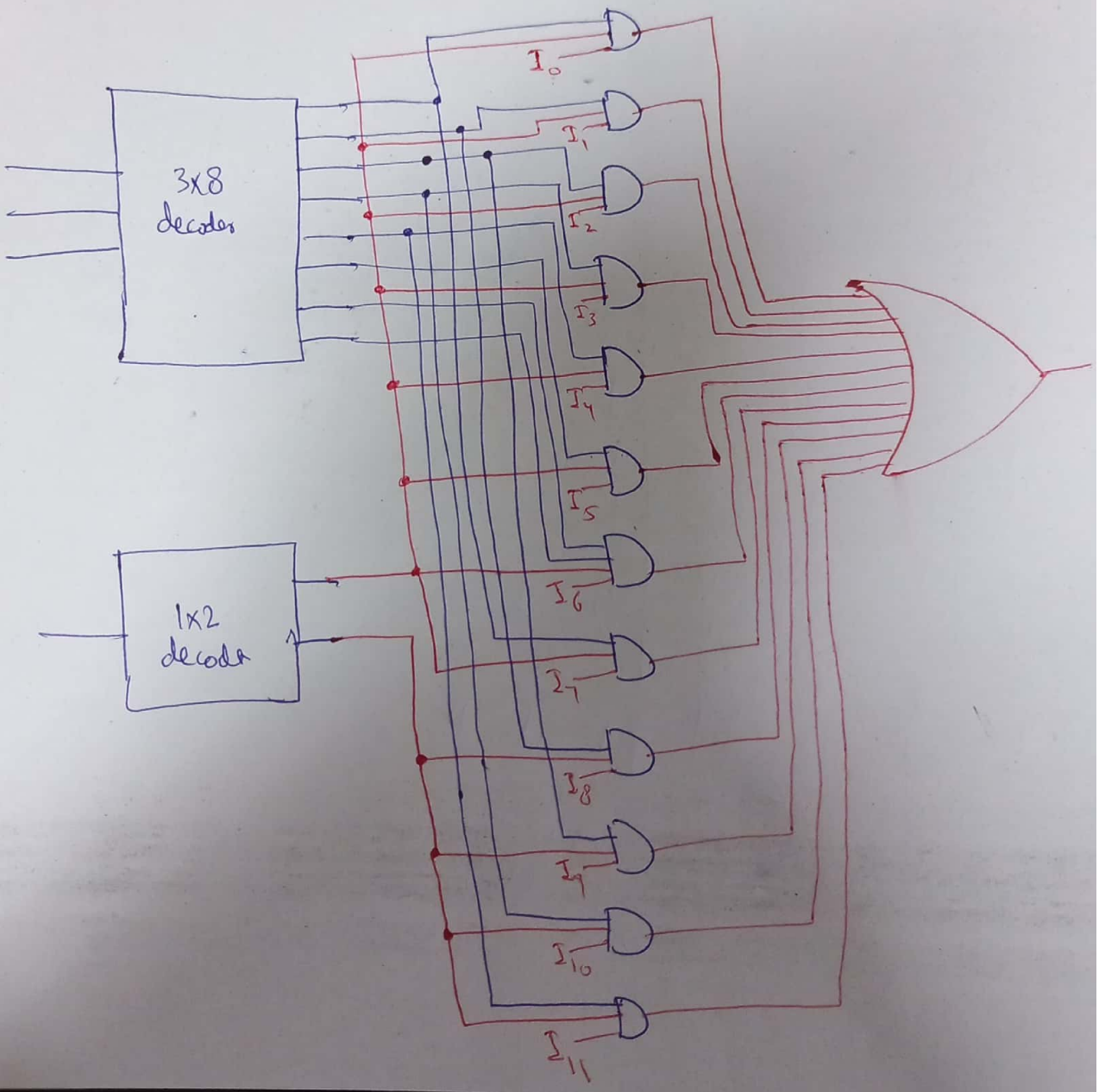
Question 01: **[5 M]**

Construct a 12–to–1-line multiplexer with a 3–to–8-line decoder, a 1–to–2- line decoder, and a 12x3 AND-OR. The selection codes 0000 through 1011 must be directly applied to the decoder inputs without added logic.



Question 02:

Implement the following Boolean function with an 8–to–1-line multiplexer and a single inverter with variable *D* as its input: **[5M]**

$$F(A, B, C, D) = \sum m(2, 4, 6, 9, 10, 11, 15)$$

A	B	C	D	F	
0	0	0	0	0	F = 0
0	0	0	1	0	
0	0	1	0	1	F = $\bar{D}$
0	0	1	1	0	
0	1	0	0	1	F = $\bar{D}$
0	1	0	1	0	
0	1	1	0	1	F = $\bar{D}$
0	1	1	1	0	
1	0	0	0	0	F = D
1	0	0	1	1	
1	0	1	0	1	F = 1
1	0	1	1	1	
1	1	0	0	0	F = 0
1	1	0	1	0	
1	1	1	0	0	F = D
1	1	1	1	1