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Lab 3

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

1. Simplify F using K-map method.

A'B'C'D CD

AB \ CD	00	01	11	10
00	0: 0	1: 1	3: 1	2: 0
01	4: 0	5: 0	7: 1	6: 0
11	12: 0	13: 1	15: 1	14: 0
10	8: 0	9: 1	11: 1	10: 0

AC'D

Simplified k-map

B'D CD

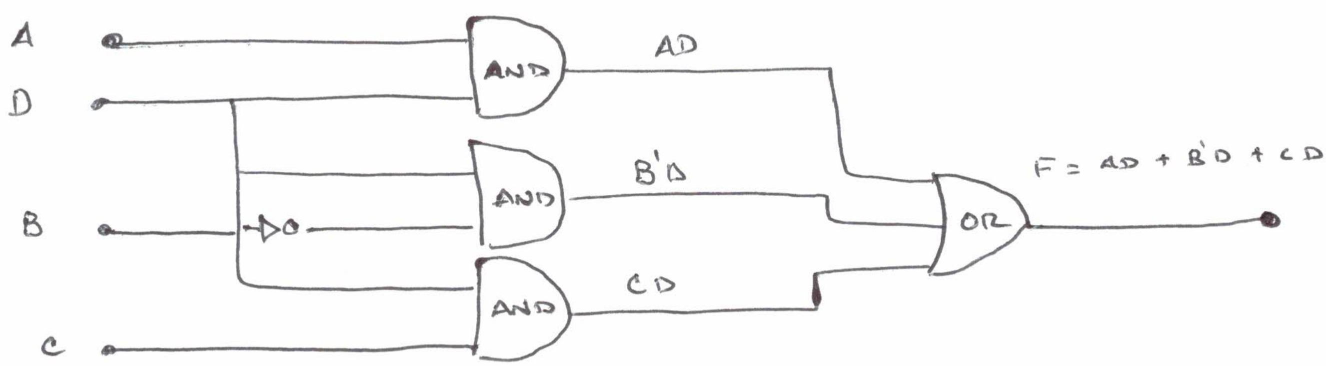
AB \ CD	00	01	11	10
00	0: 0	1: 1	3: 1	2: 0
01	4: 0	5: 0	7: 1	6: 0
11	12: 0	13: 1	15: 1	14: 0
10	8: 0	9: 1	11: 1	10: 0

AD

The simplified of F(A, B, C, D) = AD + B'D + CD

2. Draw the logic diagram (with gates) of the simplified F function from part (1).

Simplified Circuit:



Explanation:

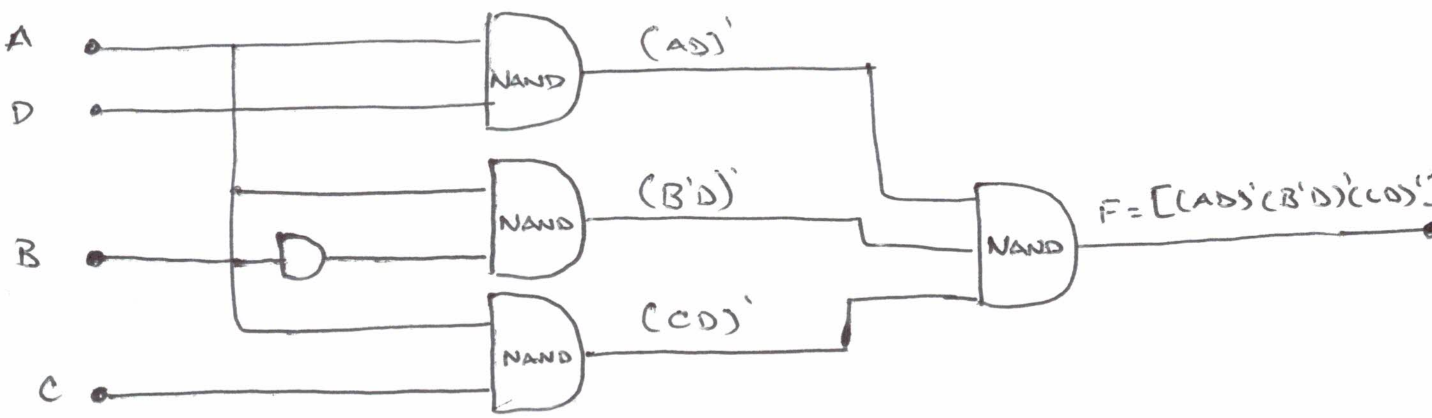
The negation of any logical identity P is nothing but opposite truth value for P. If P is T then (negation P) is F AND gate is used to find the product of two literals P AND gate Q output is PQ OR gate is used to find the sum of two literals P OR Gate Q output is P + Q.

3. Implement the logic diagram from part(2) with NAND gates.

Given F(A, B, C, D) = AD + B'D + CD

[F']' = [(AD + B'D + CD)']'

F = [(AD)'(B'D)'(CD)']'



Explanation:

NAND gate is used to find the product of two literals P NAND gate Q output is (PQ)'.

4. Simplify the function F algebraically (you should get the same as the simplified function from part(1), please use proper algebraic rules to simplify).

$F = A'B'C'D + CD + AC'D$

$F = A'B'C'D + AC'D + CD$

$F = C'D(A'B' + A) + CD$ | (by distributive law $PQ + PR = P(Q+R)$)

$F = C'D[(A' + A)(B' + A)] + CD$ | $P + QR = (P+Q)(P+R)$

$F = C'D[(1)(B' + A)] + CD$ | $P + P' = 1$

$F = (B'C'D + AC'D) + CD$ | $P(Q+R) = PQ + PR$

$F = B'C'D + D(AC' + C)$ | $PQ + PR = P(Q+R)$

$F = B'C'D[(A + C)(C' + C)]$ | $P + QR = (P+Q)(P+R)$

$F = B'C'D + D[(A + C)(1)]$ | $P + P' = 1$

$F = B'C'D + (AD + CD)$ | $P(Q+R) = PQ + PR$

$F = B'C'D + CD + AD$ |

$F = D(B'C' + C) + AD$ | $PQ + PR = P(Q+R)$

$F = D[(B' + C)(C' + C)] + AD$ | $P + QR = (P+Q)(P+R)$

$F = D[(B' + C)(1)] + AD$ | $P + P' = 1$

$F = (B'D + CD) + AD$ | $P(Q+R) = PQ + PR$

$F = AD + B'D + CD$

which is the required simplified function from part 1