

## Lab 4 - Boolean Minimization Using Quine-McCluskey Method

### Learning Outcomes

1. Minimize Boolean expression using Quine-McCluskey method.
2. Construct more complicated digital circuit.

### 1. Experiment

1. The following Boolean expression detects odd prime numbers.

$$f(A, B, C, D, E) = \sum m(1, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31)$$

- 1.1. Use Quine-McCluskey method to find prime implicants.

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Minterms	A	B	C	D	E	group
1	0	0	0	0	1	1
3	0	0	0	1	1	2
5	0	0	1	0	1	2
7	1	0	0	0	1	2
11	0	1	0	1	1	3
13	0	1	1	0	1	3
19	1	0	0	1	1	3
23	1	0	1	1	1	4
29	1	1	1	0	1	4
31	1	1	1	1	1	5

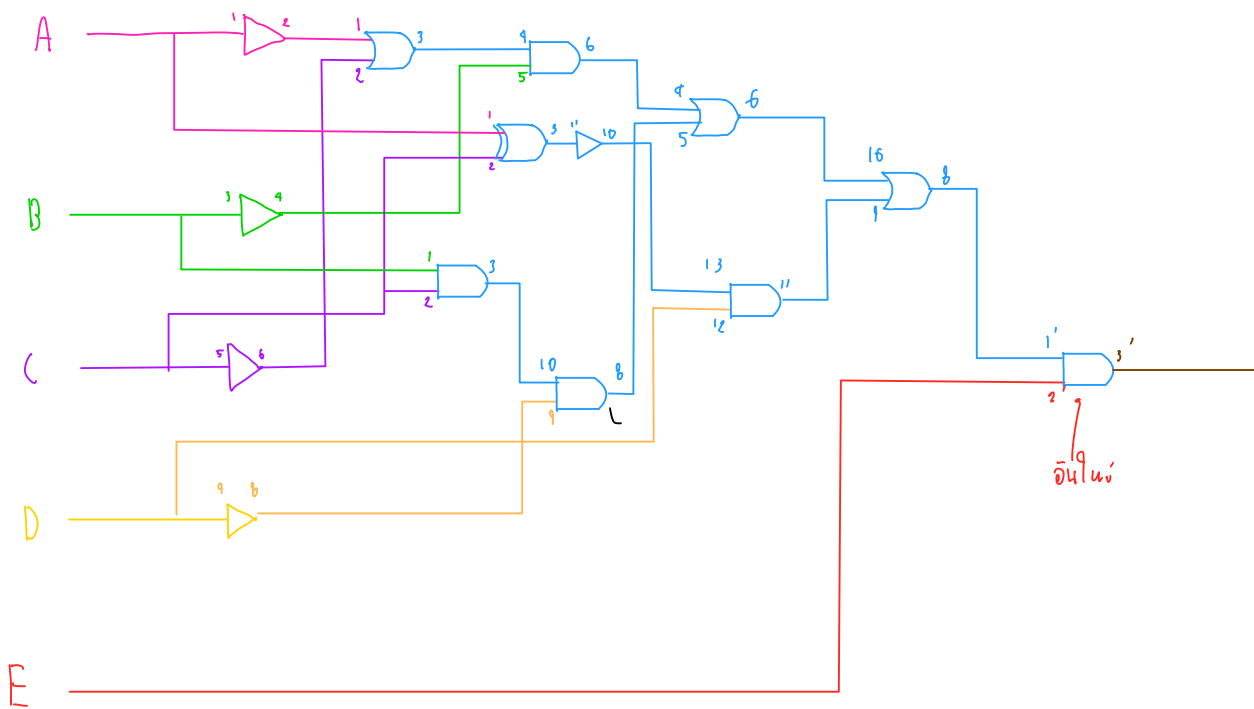
Minterms	A	B	C	D	E	
1,3	0	0	0	-	1	/
1,5	0	0	-	0	1	/
1,7	-	0	0	0	1	/
3,7	0	0	-	1	1	/
3,11	0	-	0	1	1	PI4
3,19	-	0	0	1	1	/
5,7	0	0	1	-	1	/
5,13	0	-	1	0	1	PI5
17,19	1	0	0	-	1	/
7,23	-	0	1	1	1	/
13,29	-	1	1	0	1	PI6
19,23	1	0	-	1	1	/
23,31	1	-	1	1	1	PI7
29,31	1	1	1	-	1	PI8

Minterms	A	B	C	D	E	
1,3,5,7	0	0	-	-	1	PI1
1,3,17,19	-	0	0	-	1	PI2
3,7,19,23	-	0	-	1	1	PI3

Minterm	List of prime Implicants
3,11	$A' C' D E$
5,13	$A' C D' E$
13,29	$B C D' E$
23,31	$A C D E$
29,31	$A B C E$
1,3,5,7	$A' B' E$
1,3,17,19	$B' C' E$
3,7,19,23	$B' D E$

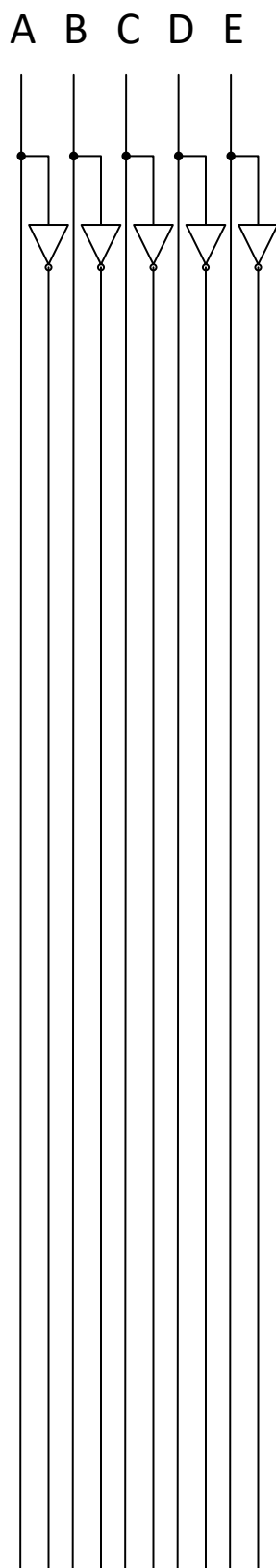


1.4. Draw logic diagram and specify IC pin No. for all input and output pins of each gate.



$$= E [ D(A \oplus C)' + B'(A' + C') + BCD' ]$$

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2. Construct the circuit from Experiment 1.4 and record the output.



## Lab 4 Submission

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### Checkpoint

Experiment 1 (10 pts)

Experiment 2 (10 pts)

### Questions

1. Can you minimize the following Boolean expression using K-Map method. If you can, do the demonstration. Or specify the reason if you cannot.

$$f(A, B, C, D, E) = \sum m(1, 3, 5, 7, 11, 13, 17, 19, 23, 29, 31)$$

	DE	$\overline{D}\overline{E}$	$\overline{D}E$	DE	$\overline{D}\overline{E}$
BC	00	01	11	10	
$\overline{B}\overline{C}$ 00	0	1	1	0	
$\overline{B}C$ 01	0	1	1	0	
BC 11	0	1	0	0	
$B\overline{C}$ 10	0	0	1	0	

$q = 0$

	DE	$\overline{D}\overline{E}$	$\overline{D}E$	DE	$\overline{D}\overline{E}$
BC	00	01	11	10	
$\overline{B}\overline{C}$ 00	0	1	1	0	
$\overline{B}C$ 01	0	0	1	0	
BC 11	0	1	1	0	
$B\overline{C}$ 10	0	0	0	0	

$q = 1$

2. Compare Quine McClusky and K-Map methods for minimization five or more variables.

Quine-McCluskey Method is suited for large numbers of variables which can handles function with five or more variables. However, it requires a lot of manual calculations if not automated. For accuracy it minimizes errors in manual operations compared to K-Maps. For the K-Map methods is become impractical when there are five or more variable due to the map's size.





$$f(A, B, C, D, E) = \bar{B}\bar{C}E + \bar{B}DE + B\bar{C}\bar{D}E + \bar{A}\bar{B}\bar{D}E \\ + \bar{A}\bar{B}CE + ACDE + ABCDE + \bar{A}B\bar{C}DE$$

$$f(A, B, C, D) = BCD'E + ABCDE + A'B'E + B'C'E$$

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