

Minimum sum-of-products

1. a) $f(a,b,c,d) = \sum m(0,1,3,5,6,7,11,12,14)$

f $ab \backslash cd$	00	01	11	10
00	1 ⁰	1 ¹	1 ³	0 ²
01	0 ⁴	1 ⁵	1 ⁷	1 ⁶
11	1 ¹²	0 ¹³	0 ¹⁵	1 ¹⁴
10	0 ¹	0 ⁹	1 ¹¹	0 ¹⁰

$\Rightarrow f(a,b,c,d) = a'd + a'b'c' + b'cd + bcd' + abd'$

b) $f(a,b,c,d,e) = \sum m(1,5,12,13,14,16,17,21,23,29,30,31) + \sum d(0,2,3,4)$

f $ab \backslash cde$	000	001	011	010	110	111	101	100
00	0 ⁰	1 ¹	0 ³	0 ²	0 ⁶	0 ⁷	1 ⁵	0 ⁴
01	0 ⁸	0 ⁹	0 ¹¹	0 ¹⁰	1 ¹⁴	0 ¹⁵	1 ¹³	1 ¹²
10	1 ⁴	0 ²⁵	0 ⁷	0 ²⁶	1 ³⁰	1 ³¹	0 ²⁹	0 ²⁸
11	1 ¹⁶	1 ¹⁷	0 ¹⁹	0 ¹⁸	0 ²²	1 ²³	1 ²¹	0 ²⁰

$\Rightarrow f(a,b,c,d,e) = b'c'd' + a'b'c' + a'cd' + ac'd'e' + b'cd'e' + abcd + ab'ce$

c) $f(a,b,c,d) = \prod M(5,7,13,14,15), \prod D(1,2,3,9)$

f $ab \backslash cd$	00	01	11	10
00	1 ⁰	0 ¹	0 ³	0 ²
01	1 ⁴	0 ⁵	0 ¹⁵	1 ¹⁴
11	1 ¹²	0 ¹³	0 ¹¹	0 ¹⁰
10	1 ⁸	0 ⁹	1 ⁷	1 ⁶

$\Rightarrow f(a,b,c,d) = c'd' + b'c + a'bd'$

2. minimum product of sums

a) $F(A, B, C, D, E) = \sum m(0, 1, 2, 6, 7, 9, 10, 15, 16, 18, 20, 21, 27, 30)$
 $+ \sum d(3, 4, 11, 12, 19)$

F	ab \ cde	000	001	011	010	110	111	101	100
00		1 ⁰	1	d ³	1 ²	1 ⁶	1 ⁷	0 ⁵	d ⁴
01		0 ⁸	1 ⁹	d ¹¹	1 ¹⁰	0 ¹⁴	1 ¹⁵	0 ¹³	d ¹²
11		0 ¹⁶	0 ¹⁷	1 ¹⁹	0 ¹⁸	1 ²²	0 ²¹	0 ²⁴	0 ²³
10		1	0 ²⁵	d	1	0 ²⁶	0 ²⁷	1	1

$\Rightarrow F(A, B, C, D, E) = (a + c' + d)(a' + b' + d)$
 $(b' + c + d + e)(a' + c + d + e')(a' + b + c' + d')$
 $(a' + c' + d + e')(a' + b' + c + d' + e)(a + b' + c' + d' + e)$

b) $F(A, B, C, D, E) = \prod M(0, 3, 6, 9, 11, 19, 20, 24, 25, 26, 27, 28, 29, 30) + \prod D(1, 2, 12, 13)$

F	ab \ cde	000	001	011	010	110	111	101	100
00		0 ⁰	d ¹	0 ³	d ²	0 ⁶	1 ⁷	1 ⁵	1 ⁴
01		1 ⁸	0	0	1	1 ¹¹	1 ¹⁵	d ¹³	d ¹²
11		0 ¹⁶	0 ¹⁷	0 ¹⁹	0 ¹⁸	0 ²²	1 ²¹	0 ²⁴	0 ²³
10		1	1	0	1	1	1	0	0

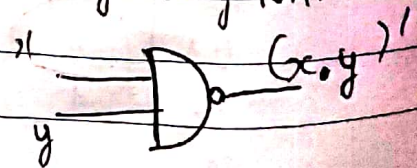
$\Rightarrow F(A, B, C, D, E) = (a + b + c)(a + b')(c + d' + e')$
 $(b' + c + e')(a' + b' + d)(a' + b')(a' + c' + d + e)$

3.

$F = w'x' + xy + wy'$

chỉ dùng cổng NAND 2 đầu vào

x	y	w	w'x'	xy	wy'	F
0	0	0	1	0	0	1
0	0	1	0	0	1	1
0	1	0	1	0	0	1
0	1	1	0	0	0	0
1	0	0	0	0	0	0
1	0	1	0	0	1	1



F	x	y	w	00	01	11	10
0	0	0	0	1 ⁴	1 ⁵	0 ³	1 ²
1	0	0	1	0	0	1	0
0	0	1	0	0	0	0	0
1	0	1	1	0	0	0	0
0	1	0	0	0	0	0	0
1	1	0	1	0	0	0	0
0	1	1	0	0	0	0	0
1	1	1	1	0	0	0	0

$$(x' + y + w)(x + y' + w)$$

$$(x \cdot x)' = x'$$

$$F = w'x' + xy + wy'$$

$$= ((w'x' + xy + wy'))'$$

$$= [(w'x')', (xy)', (wy')']'$$

$$= [[(w, w)', (x, x)'], (xy)', (w, (y, y)')]'$$

