

**ITI1100C**  
**Assignment # 3**  
**SOLUTIONS**

**3.2**

|          |   |           |       |          |       |    |  |
|----------|---|-----------|-------|----------|-------|----|--|
|          |   | <i>yz</i> |       | <i>y</i> |       |    |  |
|          |   | <i>x</i>  | 00    | 01       | 11    | 10 |  |
| <i>x</i> | 0 | $m_0$     | $m_1$ | $m_3$    | $m_2$ |    |  |
|          | 1 | $m_4$     | $m_5$ | $m_7$    | $m_6$ |    |  |
|          |   |           |       | <i>z</i> |       |    |  |

**(a)**  $F = x'y' + xz$

|          |   |           |       |          |       |    |  |
|----------|---|-----------|-------|----------|-------|----|--|
|          |   | <i>yz</i> |       | <i>y</i> |       |    |  |
|          |   | <i>x</i>  | 00    | 01       | 11    | 10 |  |
| <i>x</i> | 0 | $m_0$     | $m_1$ | $m_3$    | $m_2$ |    |  |
|          | 1 | $m_4$     | $m_5$ | $m_7$    | $m_6$ |    |  |
|          |   |           |       | <i>z</i> |       |    |  |

**(b)**  $F = y + x'z$

|          |   |           |       |          |       |    |  |
|----------|---|-----------|-------|----------|-------|----|--|
|          |   | <i>yz</i> |       | <i>y</i> |       |    |  |
|          |   | <i>x</i>  | 00    | 01       | 11    | 10 |  |
| <i>x</i> | 0 | $m_0$     | $m_1$ | $m_3$    | $m_2$ |    |  |
|          | 1 | $m_4$     | $m_5$ | $m_7$    | $m_6$ |    |  |
|          |   |           |       | <i>z</i> |       |    |  |

**(c)**  $F = xy' + x'y$

|          |   |           |       |          |       |    |  |
|----------|---|-----------|-------|----------|-------|----|--|
|          |   | <i>yz</i> |       | <i>y</i> |       |    |  |
|          |   | <i>x</i>  | 00    | 01       | 11    | 10 |  |
| <i>x</i> | 0 | $m_0$     | $m_1$ | $m_3$    | $m_2$ |    |  |
|          | 1 | $m_4$     | $m_5$ | $m_7$    | $m_6$ |    |  |
|          |   |           |       | <i>z</i> |       |    |  |

**(d)**  $F = y + z$

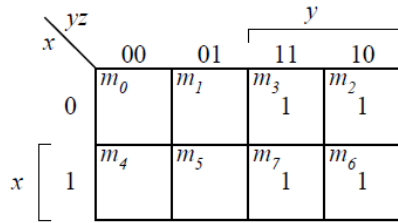
|          |   |           |       |          |       |    |  |
|----------|---|-----------|-------|----------|-------|----|--|
|          |   | <i>yz</i> |       | <i>y</i> |       |    |  |
|          |   | <i>x</i>  | 00    | 01       | 11    | 10 |  |
| <i>x</i> | 0 | $m_0$     | $m_1$ | $m_3$    | $m_2$ |    |  |
|          | 1 | $m_4$     | $m_5$ | $m_7$    | $m_6$ |    |  |
|          |   |           |       | <i>z</i> |       |    |  |

**(e)**  $F = z'$

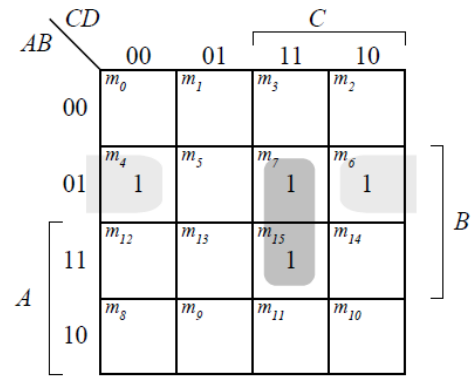
|          |   |           |       |          |       |    |  |
|----------|---|-----------|-------|----------|-------|----|--|
|          |   | <i>yz</i> |       | <i>y</i> |       |    |  |
|          |   | <i>x</i>  | 00    | 01       | 11    | 10 |  |
| <i>x</i> | 0 | $m_0$     | $m_1$ | $m_3$    | $m_2$ |    |  |
|          | 1 | $m_4$     | $m_5$ | $m_7$    | $m_6$ |    |  |
|          |   |           |       | <i>z</i> |       |    |  |

**(f)**  $F = x + yz$

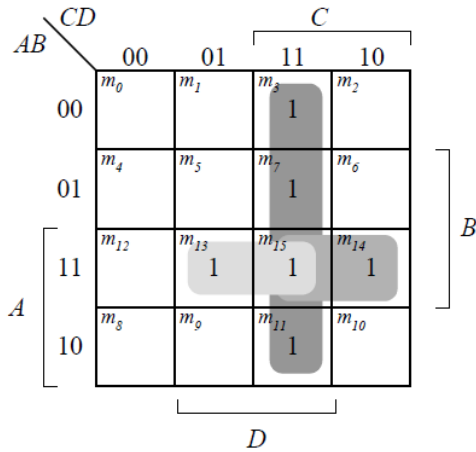
### 3.4



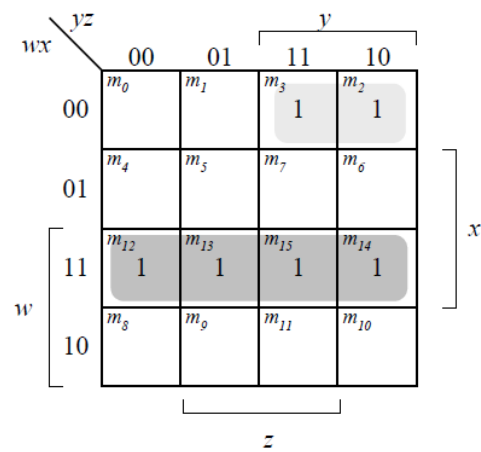
(a)  $F = y$



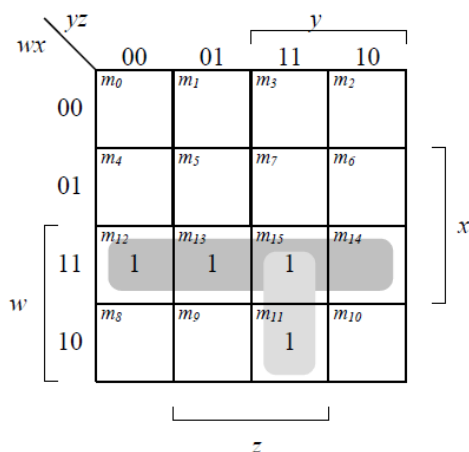
(b)  $F = BCD + A'BD'$



(c)  $F = CD + ABD + ABC$

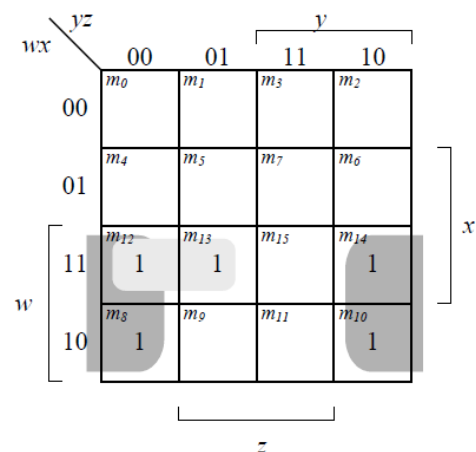


(d)  $F = w'x'y + wx$



(e)

$$F = wx + wyz$$



(f)

$$F = wz' + xy'w$$

3.4 (g)

| wx \ yz | 00 | 01 | 11 | 10 |
|---------|----|----|----|----|
| 00      | 1  | 1  |    |    |
| 01      | 1  | 1  |    |    |
| 11      |    |    | 1  | 1  |
| 10      |    |    | 1  | 1  |

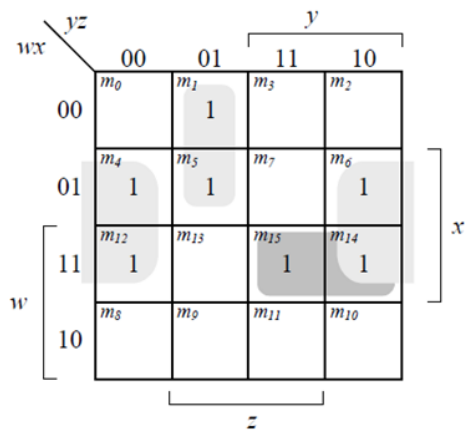
$$F = w'y' + wy$$

3.4 (h)

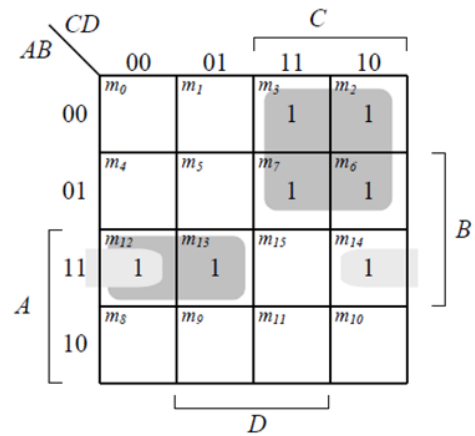
| wx \ yz | 00 | 01 | 11 | 10 |
|---------|----|----|----|----|
| 00      |    |    | 1  | 1  |
| 01      |    |    | 1  | 1  |
| 11      | 1  | 1  |    |    |
| 10      | 1  | 1  |    |    |

$$F = wy' + w'y$$

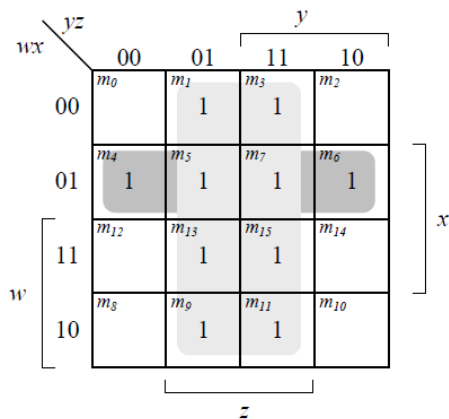
### 3.5



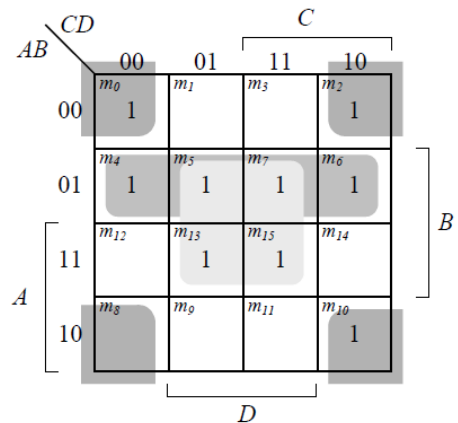
(a)  $F = xz' + w'y'z + wx'y$



(b)  $F = A'C + ABC' + ABD'$



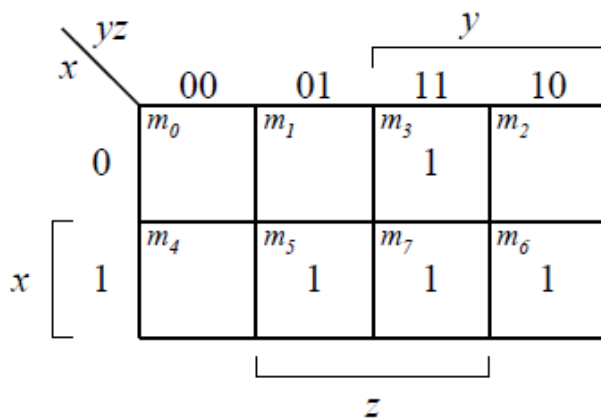
(c)  $F = z + xw'$



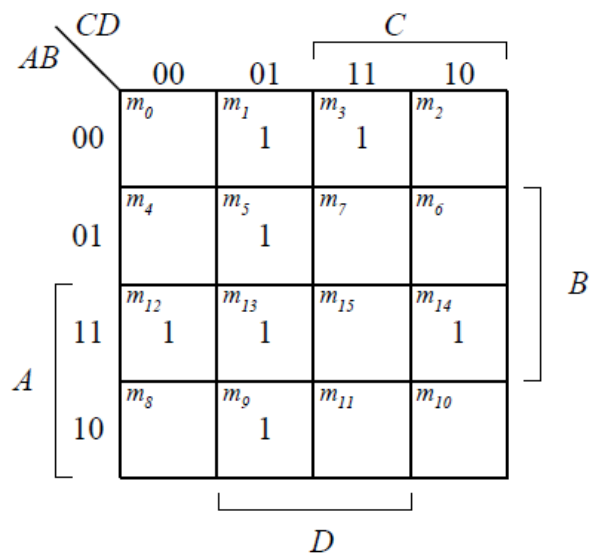
(d)  $F = BD + A'B + B'D'$   
or  $= BD + B'D' + A'D'$

### 3.8

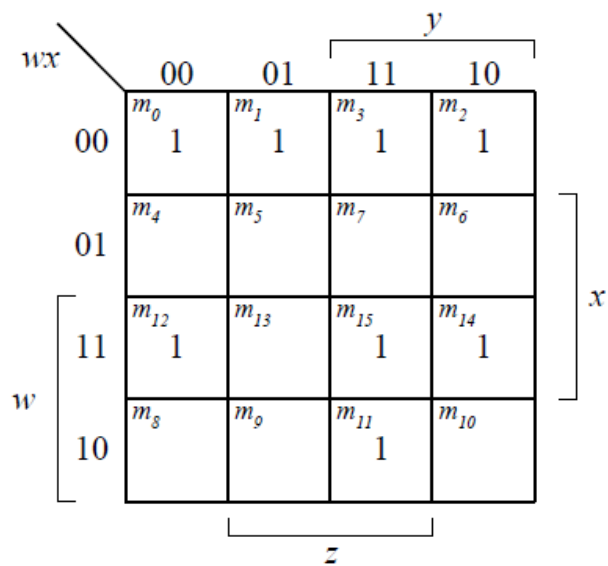
(a)  $F(x, y, z) = \Sigma(3, 5, 6, 7)$



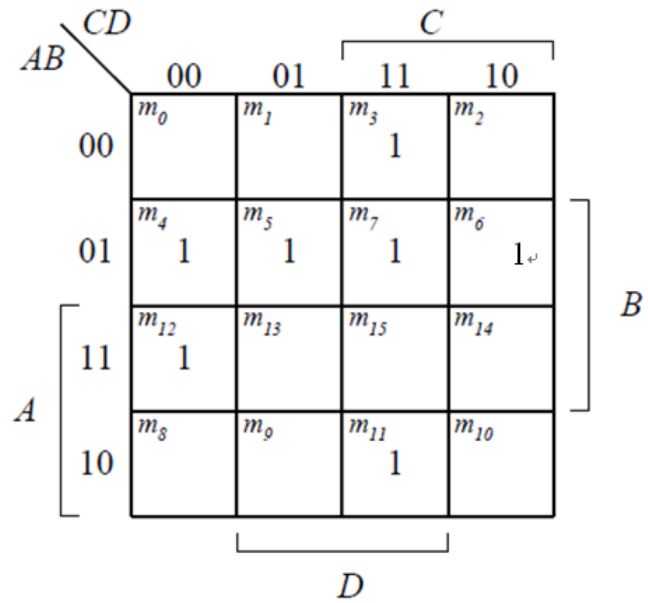
(b)  $F = \Sigma(1, 3, 5, 9, 12, 13, 14)$



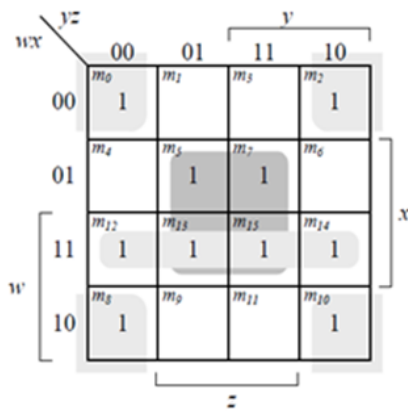
(c)  $F = \Sigma(0, 1, 2, 3, 11, 12, 14, 15)$



(d)  $F = \Sigma(3, 4, 5, 6, 7, 11, 12)$



3.10



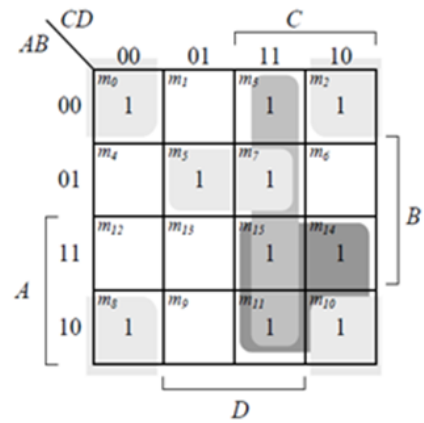
$F = \Sigma(0, 2, 5, 7, 8, 10, 12, 13, 14, 15)$

Essential:  $xz, x'z'$

$F = xz + x'z' + wx$  or

$F = xz + x'z' + wz'$

(a)



$F = \Sigma(0, 2, 3, 5, 7, 8, 10, 11, 14, 15)$

Essential:  $AC, B'D', A'BD'$

$F = AC + B'D' + A'BD + CD$  or

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

(b)

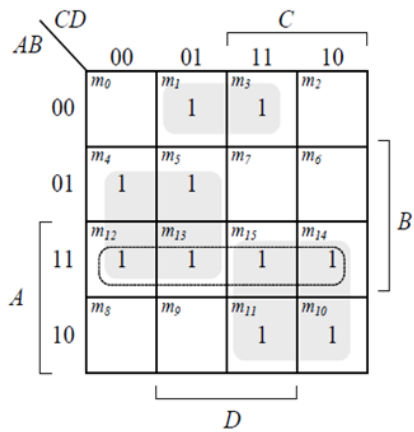
Note: From the course notes:

Essential:  $AC, B'D', A'BD, AC$  (current grouping)

Essential:  $wx, x'z', xz$  (current grouping) or  $AC, B'D', A'BD, B'C$  (different Grouping)

or  $wz', x'z', xz$  (different grouping)

Only essentials are listed in the function (depending the selected grouping)

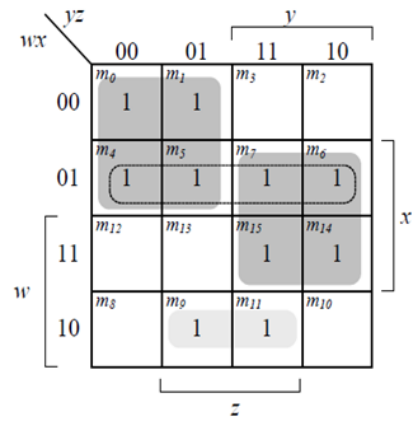


$F = \Sigma(1, 3, 4, 5, 10, 11, 12, 13, 14, 15)$

**Essential:** AC, BC'

$F = AC + BC' + A'B'D'$

(c)



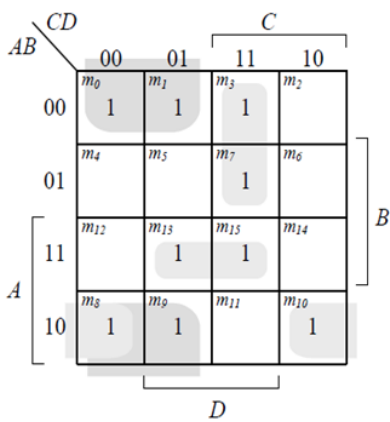
$F = \Sigma(0, 1, 4, 5, 6, 7, 9, 11, 14, 15)$

**Essential:** w'y', xy

$F = w'y' + xy + wx'z$

(d)

Use the same approach as for 3.10

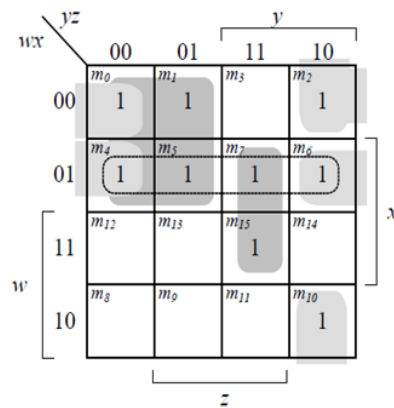


$F(A, B, C, D) = S(0, 1, 3, 7, 8, 9, 10, 13, 15)$

**Essential:** B'C', AB'D'

$F = B'C' + AB'D' + A'CD + ABD$

(e)



$F = S(0, 1, 2, 4, 5, 6, 7, 10, 15)$

**Essential:** w'y', xyz, x'yz'

$F = w'y' + xyz + x'yz' + w'z'$  or

$F = w'y' + xyz + x'yz' + w'x$

(f)

Use the same approach as for 3.10

### 3.15

|     |   |            |            |            |            |
|-----|---|------------|------------|------------|------------|
|     |   | $yz$       |            | $y$        |            |
|     |   | 00         | 01         | 11         | 10         |
| $x$ | 0 | $m_0$<br>1 | $m_1$<br>1 | $m_3$<br>X | $m_2$<br>X |
|     | 1 | $m_4$<br>1 | $m_5$<br>1 | $m_7$<br>X | $m_6$<br>1 |
|     |   | $z$        |            |            |            |

$F = 1$   
 $F = \Sigma(0,1, 2, 3, 4, 5, 6, 7)$

|      |    |      |    |    |    |
|------|----|------|----|----|----|
|      |    | $CD$ |    |    |    |
|      |    | 00   | 01 | 11 | 10 |
| $AB$ | 00 | 1    |    |    | X  |
|      | 01 | X    |    |    | 1  |
|      | 11 |      | 1  |    | 1  |
|      | 10 | 1    |    |    | X  |

$F = B'D' + CD' + ABC'D$   
 $F = \Sigma(0, 2, 6, 8, 10, 13, 14)$

|      |    |      |    |    |    |
|------|----|------|----|----|----|
|      |    | $CD$ |    |    |    |
|      |    | 00   | 01 | 11 | 10 |
| $AB$ | 00 |      |    | X  |    |
|      | 01 |      | 1  | 1  | 1  |
|      | 11 | 1    |    | 1  | 1  |
|      | 10 |      | X  | X  |    |

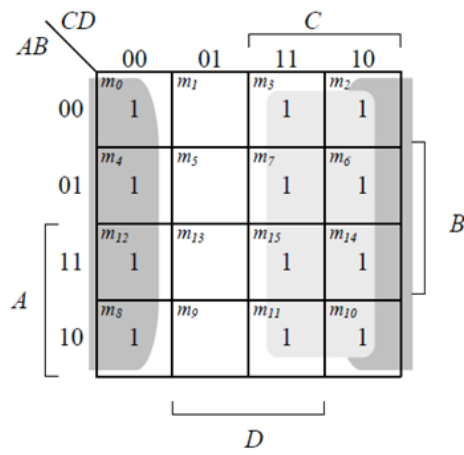
$F = BC + ABD' + A'BD$   
 $F = \Sigma(5, 6, 7, 12, 14, 15)$

|      |    |               |          |            |               |     |
|------|----|---------------|----------|------------|---------------|-----|
|      |    | $CD$          |          |            |               | $C$ |
|      |    | 00            | 01       | 11         | 10            |     |
| $AB$ | 00 | $m_0$<br>X    | $m_1$    | $m_3$      | $m_2$<br>1    | $B$ |
|      | 01 | $m_4$<br>1    | $m_5$    | $m_7$<br>1 | $m_6$<br>X    |     |
|      | 11 | $m_{12}$<br>1 | $m_{13}$ | $m_{15}$   | $m_{14}$      |     |
|      | 10 | $m_8$<br>X    | $m_9$    | $m_{11}$   | $m_{10}$<br>1 |     |
|      |    | $D$           |          |            |               |     |

$F = B'D' + C'D' + A'BC$   
 $F = \Sigma(0, 2, 4, 6, 7, 8, 10, 12)$

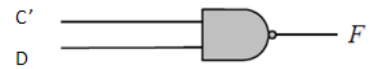
### 3.16

(a)

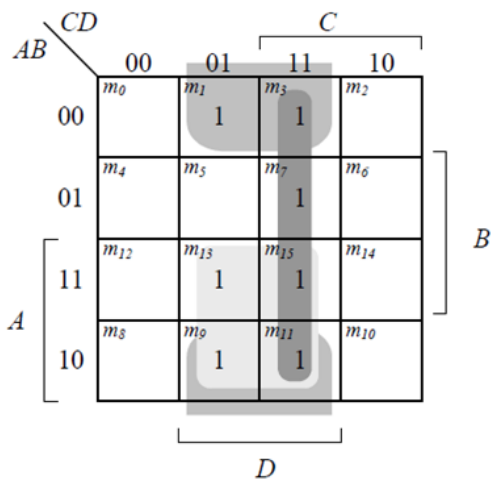


$$F = C + D'$$

$$F = (C'D)'$$

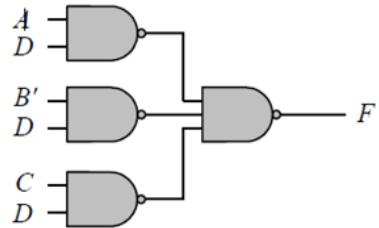


(b)

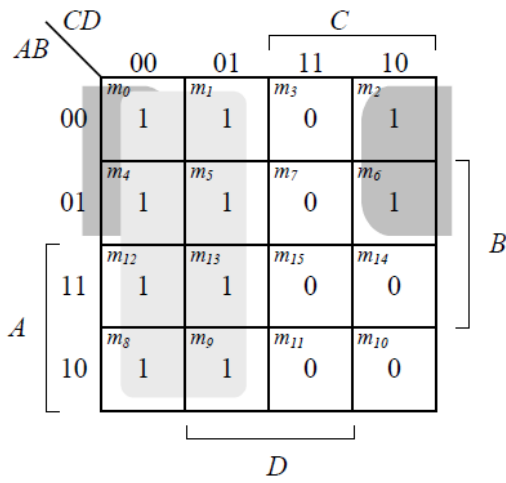


$$F = AD + B'D + CD$$

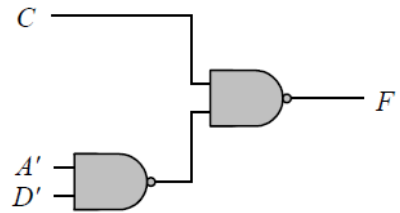
$$F = ((AD)' (B'D)' (CD))'$$



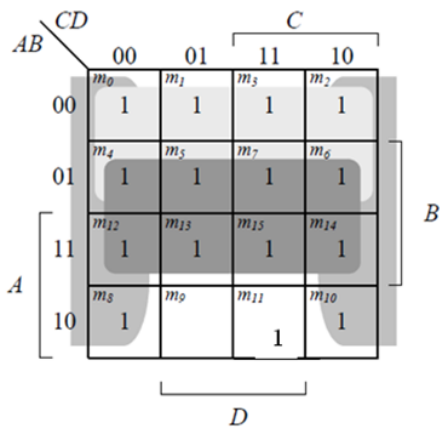
(c)  $F = (A' + C' + D')(A' + C')(C' + D')$   
 $F' = (A' + C' + D)' + (A' + C)' + (C' + D)'$   
 $F' = ACD + AC + CD$



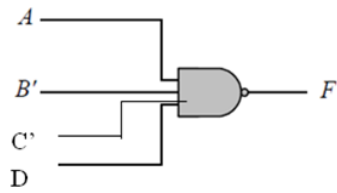
$F = C' + A'D'$   
 $F = (C(A + D))'$   
 $F = (C(A'D'))'$



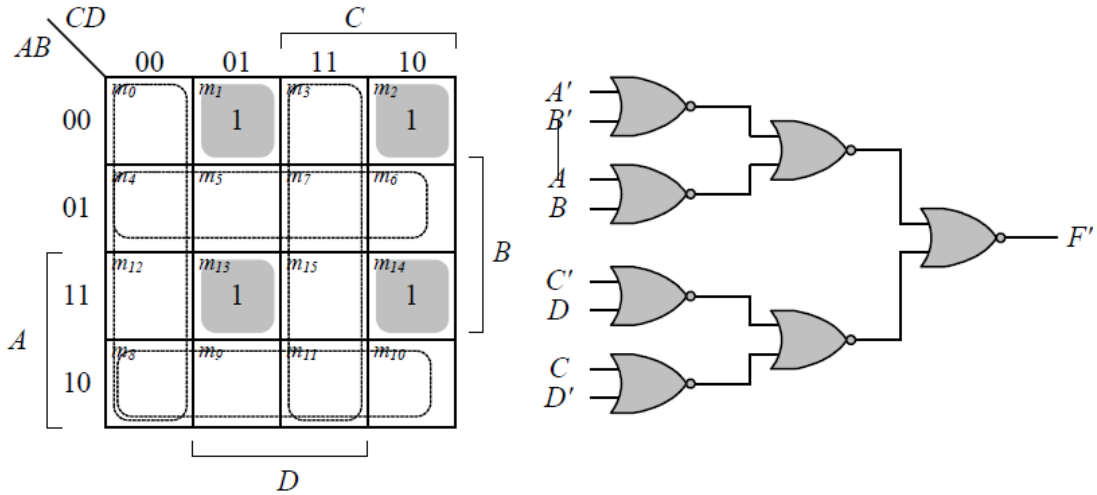
(d)



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



$$\begin{aligned}
 F &= (A \oplus B)'(C \oplus D) = (AB' + A'B)'(CD' + C'D) \\
 &= (AB + A'B')(CD' + C'D) = ABCD' + ABC'D + A'B'CD' + A'B'C'D \\
 F' &= (AB + A'B')' + (CD' + C'D)' \\
 F' &= ((A' + B)') + (A + B)')' + ((C' + D)') + (C + D)')'
 \end{aligned}$$



(b)

$$F = (AB + A'B')(C'D + CD')$$

$$F = ((AB + A'B')') ((C'D + CD')')$$

$$F = ((AB)' \cdot (A'B')') ((C'D)' \cdot (CD')')$$

$$F' = (((AB)' \cdot (A'B')') ((C'D)' \cdot (CD')'))'$$

