

# ECE 462 HW #2 Solutions

①

$$f = \sum (3, 5, 7, 11, 12, 29, 31) + d(1, 2, 6, 10, 28)$$

|    | V | W | X | Y | Z |   |
|----|---|---|---|---|---|---|
| 1  | 0 | 0 | 0 | 0 | 1 | ✓ |
| 2  | 0 | 0 | 0 | 1 | 0 | ✓ |
| 3  | 0 | 0 | 0 | 1 | 1 | ✓ |
| 5  | 0 | 0 | 1 | 0 | 1 | ✓ |
| 6  | 0 | 0 | 1 | 1 | 0 | ✓ |
| 10 | 0 | 1 | 0 | 1 | 0 | ✓ |
| 12 | 0 | 1 | 1 | 0 | 0 | ✓ |
| 7  | 0 | 0 | 1 | 1 | 1 | ✓ |
| 11 | 0 | 1 | 0 | 1 | 1 | ✓ |
| 28 | 1 | 1 | 1 | 0 | 0 | ✓ |
| 29 | 1 | 1 | 1 | 0 | 1 | ✓ |
| 31 | 1 | 1 | 1 | 1 | 1 | ✓ |

|               | V | W | X | Y | Z |
|---------------|---|---|---|---|---|
| • (1,3,5,7)   | 0 | 0 | - | 1 | - |
| • (2,3,6,7)   | 0 | 0 | - | 1 | - |
| • (2,3,10,11) | 0 | - | 0 | 1 | - |

Prime Implicants:

$$WX Y' Z', VW X Y', WX Y Z, V' W' Z, V' X' Y$$

|           | V | W | X | Y | Z |   |
|-----------|---|---|---|---|---|---|
| (1,3)     | 0 | 0 | 0 | - | 1 | ✓ |
| (1,5)     | 0 | 0 | - | 0 | 1 | ✓ |
| (2,3)     | 0 | 0 | 0 | 1 | - | ✓ |
| (2,6)     | 0 | 0 | - | 1 | 0 | ✓ |
| (2,10)    | 0 | - | 0 | 1 | 0 | ✓ |
| (3,7)     | 0 | 0 | - | 1 | 1 | ✓ |
| (3,11)    | 0 | - | 0 | 1 | 1 | ✓ |
| (5,7)     | 0 | 0 | 1 | - | 1 | ✓ |
| (6,7)     | 0 | 0 | 1 | 1 | - | ✓ |
| (10,11)   | 0 | 1 | 0 | 1 | - | ✓ |
| • (12,28) | - | 1 | 1 | 0 | 0 |   |
| • (28,29) | 1 | 1 | 1 | 0 | - |   |
| • (29,31) | 1 | 1 | 1 | - | 1 |   |

①

(2) 6.1 K

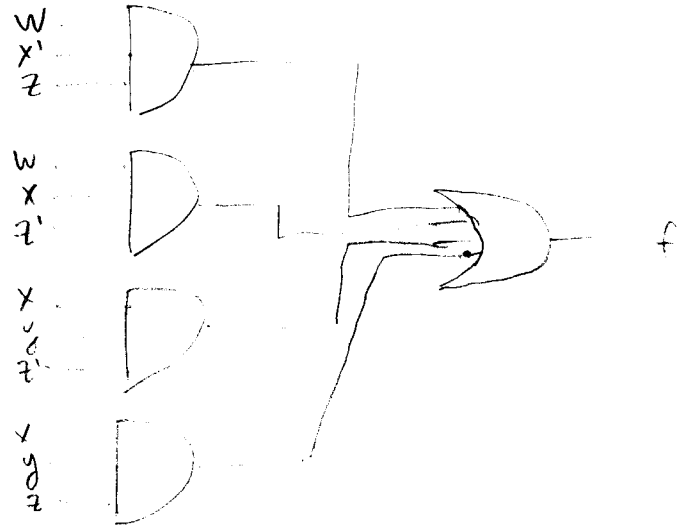
|    |    | yz |    |    |    |
|----|----|----|----|----|----|
|    | wx | 00 | 01 | 11 | 10 |
| 00 | 0  | 0  | 0  | 1  |    |
| 01 | 0  | 0  | 1  | 0  |    |
| 11 | 1  | 0  | 1  | 1  |    |
| 10 | 0  | 1  | 1  | 1  |    |

prime implicants:

$w\bar{y}$ ,  $wx'z$ ,  $x'y\bar{z}$ ,  $x'yz$ ,  $wxz'$

P.I. Table

|               | 2 | 7 | 9 | 10 | 11 | 12 | 14 | 15 |
|---------------|---|---|---|----|----|----|----|----|
| wy            |   |   |   | x  | x  |    | x  | x  |
| *wxz          |   |   | x |    | x  |    |    |    |
| *wxz'         |   |   |   |    |    | x  | x  |    |
| *xy $\bar{z}$ | x |   |   | x  |    |    |    |    |
| *xyz          |   | x |   |    |    |    |    | x  |



Minimum Sum:  $f = wx'z + wxz' + xy\bar{z} + xyz$

(3) P.I's:  $v'wx$ ,  $vwx$ ,  $v'wz$ ,  $wx'z$ ,  $v'z$

|       | 9 | 11 | 12 | 13 | 14 | 15 | 16 | 18 | 24 | 25 | 26 | 27 |
|-------|---|----|----|----|----|----|----|----|----|----|----|----|
| *v'wx |   |    | x  | x  | x  | x  |    |    |    |    |    |    |
| vwx'  |   |    |    |    |    |    |    |    | x  | x  | x  | x  |
| v'wz  | x | x  |    | x  |    | x  |    |    |    |    |    |    |
| wx'z  | x | x  |    |    |    |    |    |    |    | x  |    |    |
| *v'z  |   |    |    |    |    |    | x  | x  | x  |    |    | x  |

reduced table

|      | 9 | 11 | 25 | 27 |
|------|---|----|----|----|
| vwx' |   |    | x  | x  |
| v'wz | x | x  |    |    |
| wx'z | x | x  | x  | x  |

$wx'z$  dominates  $vwx'$  &  $v'wz$

| $wx'z$ | 9 | 11 | 25 | 27 |
|--------|---|----|----|----|
|        | x | x  | x  | x  |

min Sum:

$f = v'wx + v'z + wx'z$

(2)

$$(4) \quad f(w, x, y, z) = x'y'z' + xz + w'x'y + wx'$$

$$L = (x'y'z', xz, w'x'y, wx')$$

with respect to  $w$ :

$$\text{cons}(w'x'y, wx') = x'y \text{ covers } w'x'y$$

$$L = (x'y'z', xz, x'y, wx')$$

with respect to  $x$ :

$$\text{cons}(x'y'z', xz) = \text{none}$$

$$\text{cons}(xz, x'y) = yz$$

$$\text{cons}(xz, x'w) = wz$$

$$L = (x'y'z', xz, x'y, wx', yz, wz)$$

with respect to  $y$ :

$$\text{cons}(x'y'z', x'y) = x'z' \text{ covers } x'y'z'$$

$$\text{cons}(x'y'z', yz) = \text{none}$$

$$L = (xz, x'y, wx', yz, wz, x'z')$$

with respect to  $z$ :

$$\text{cons}(xz, x'z') = \text{none}$$

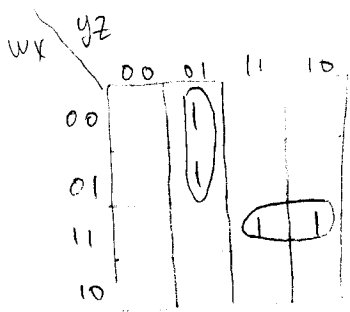
$$\text{cons}(yz, x'z') = x'y \rightarrow \text{already in } L$$

$$\text{cons}(wz, x'z') = wx' \rightarrow \text{already in } L$$

$$\text{P.I.'S.} = L = \underline{xz, x'y, wx', yz, wz, x'z'}$$

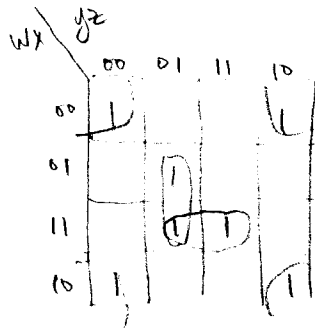
(5)  $f_1 = wxy + w'y'z$   
 $f_2 = x'z' + wxz + xy'z$   
 $f_3 = x'z' + wxy'z + w'x'y'$

\* only 1's are shown in K-maps



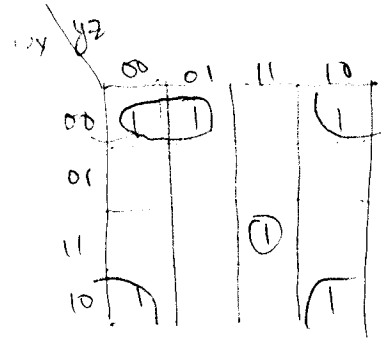
$f_1$

P.I.'S:  $wxy, w'y'z$



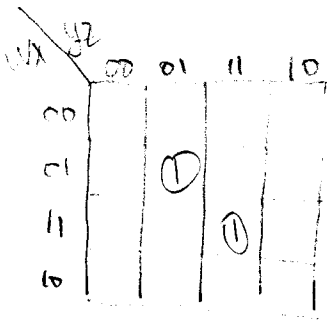
$f_2$

P.I.'S:  $x'z', wxz, xy'z$



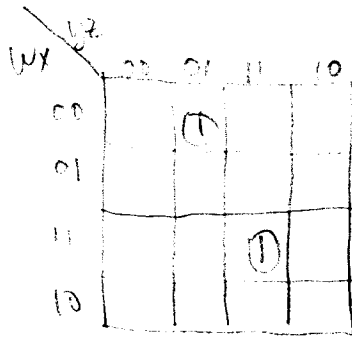
$f_3$

P.I.'S:  $x'z', wxy'z, w'x'y'$



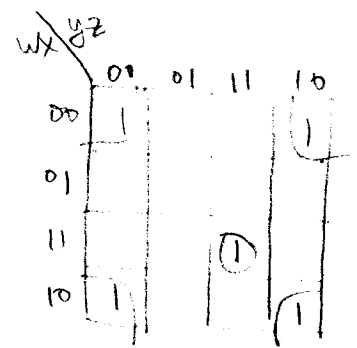
$f_1 \cdot f_2$

P.I.'S:  $w'xy'z, wxyz$



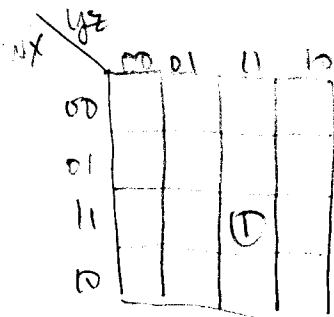
$f_1 \cdot f_3$

P.I.'S:  $w'xy'z, wxyz$



$f_2 \cdot f_3$

P.I.'S:  $x'z', wxy'z$



$f_1 \cdot f_2 \cdot f_3$

P.I.'S:  $wxyz$

MOP I'S:  $wxy, w'y'z, x'z', wxz, xy'z, wxy'z, w'x'y', w'xy'z, w'x'y'z$

(b)

|      | w | x | y | z | $f_1$ | $f_2$ | $f_3$ |   |
|------|---|---|---|---|-------|-------|-------|---|
| 0    | 0 | 0 | 0 | 0 | 0     | 1     | 1     | ✓ |
| * 1  | 0 | 0 | 0 | 1 | 1     | 0     | 1     |   |
| 2    | 0 | 0 | 1 | 0 | 0     | 1     | 1     | ✓ |
| 8    | 1 | 0 | 0 | 0 | 0     | 1     | 1     | ✓ |
| * 5  | 0 | 1 | 0 | 1 | 1     | 1     | 0     |   |
| 10   | 1 | 0 | 1 | 0 | 0     | 1     | 1     | ✓ |
| 13   | 1 | 1 | 0 | 1 | 0     | 1     | 0     | ✓ |
| 14   | 1 | 1 | 1 | 0 | 1     | 0     | 0     | ✓ |
| * 15 | 1 | 1 | 1 | 1 | 1     | 1     | 1     |   |

|           | w | x | y | z | $f_1$ | $f_2$ | $f_3$ |   |
|-----------|---|---|---|---|-------|-------|-------|---|
| * (0,1)   | 0 | 0 | 0 | 1 | 0     | 0     | 1     |   |
| (0,2)     | 0 | 0 | 1 | 0 | 0     | 1     | 1     | ✓ |
| (0,8)     | 1 | 0 | 0 | 0 | 0     | 1     | 1     | ✓ |
| * (1,5)   | 0 | 1 | 0 | 1 | 1     | 0     | 0     |   |
| (2,10)    | 1 | 0 | 1 | 0 | 0     | 1     | 1     | ✓ |
| (8,10)    | 1 | 0 | 1 | 0 | 0     | 1     | 1     | ✓ |
| * (5,13)  | 1 | 1 | 0 | 1 | 0     | 1     | 0     |   |
| * (13,15) | 1 | 1 | 1 | 1 | 0     | 1     | 0     |   |
| * (14,15) | 1 | 1 | 1 | 1 | 1     | 0     | 0     |   |

|              | w | x | y | z | $f_1$ | $f_2$ | $f_3$ |
|--------------|---|---|---|---|-------|-------|-------|
| * (0,2,8,10) | 1 | 0 | 1 | 0 | 0     | 1     | 1     |

MOPs:  $w'x'y'z$ ,  $w'xy'z$ ,  $wxy'z$ ,  $w'x'y$ ,  $w'y'z$ ,  $xy'z$ ,  $wxz$ ,  $wxy$ ,  $x'z$