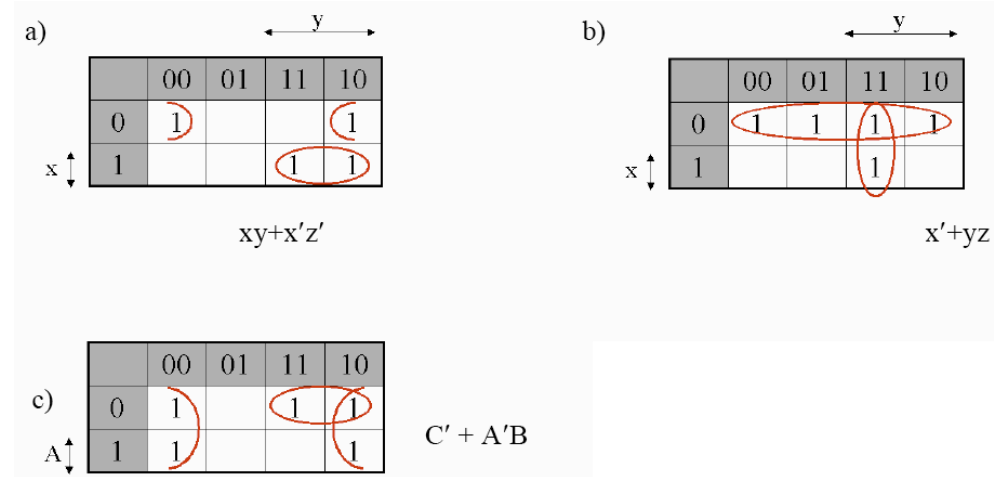1) Simplify the following Boolean functions in **sum-of-products**, using K-maps:
a) xy + x′y′z′ + x′yz′
b) x′y′ + yz + x′yz′
c) A′B + BC′ + B′C′
Sol:

a)

| x \ y | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | 1 |  |  | 1 |
| 1 |  |  | 1 | 1 |

xy+x′z′

b)

| x \ y | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | 1 | 1 | 1 | 1 |
| 1 |  |  | 1 |  |

x′+yz

c)

| A \ | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | 1 |  | 1 | 1 |
| 1 | 1 |  |  | 1 |

C′ + A′B

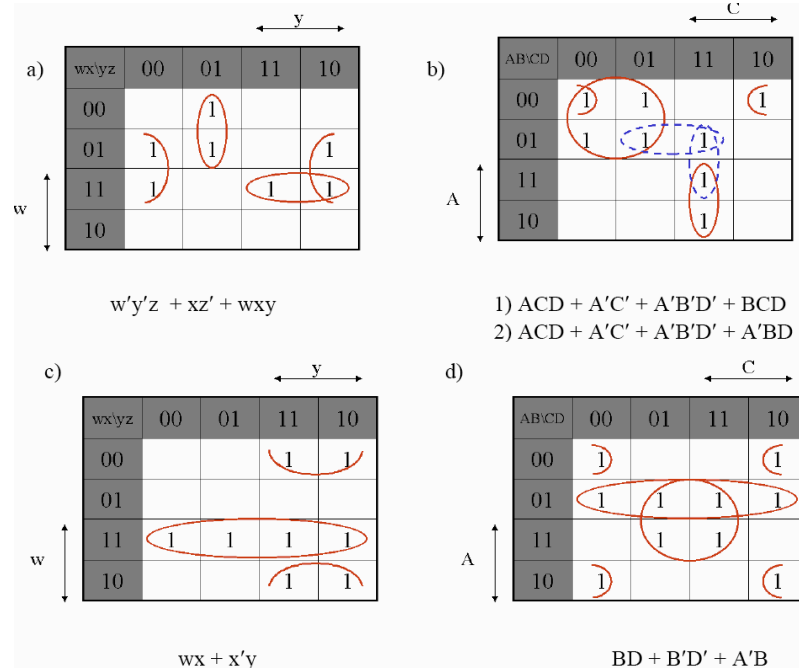2) Simplify the following Boolean functions in **sum-of-products**, using K-maps:
a) F(w, x, y, z) = Σ (1, 4, 5, 6, 12, 14, 15)
b) F(A, B, C, D) = Σ (0, 1, 2, 4, 5, 7, 11, 15)
c) F(w, x, y, z) = Σ (2, 3, 10, 11, 12, 13, 14, 15)
d) F(A, B, C, D) = Σ (0, 2, 4, 5, 6, 7, 8, 10, 13, 15)
Sol:

a)

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

w′y′z  + xz′ + wxy

b)

| AB\CD | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 1 | 1 |  | 1 |
| 01 | 1 | 1 | 1 |  |
| 11 |  |  | 1 |  |
| 10 |  |  | 1 |  |

1) ACD + A′C′ + A′B′D′ + BCD
2) ACD + A′C′ + A′B′D′ + A′BD

c)

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

wx + x′y

d)

| AB\CD | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 00 | 1 |  |  | 1 |
| 01 | 1 | 1 | 1 | 1 |
| 11 |  |  | 1 |  |
| 10 | 1 |  |  | 1 |

BD + B′D′ + A′B

3) Simplify the following Boolean functions in **products-of-sums**:
a) $F(w, x, y, z) = \Sigma (0, 2, 5, 6, 7, 8, 10)$
b) $F(A, B, C, D) = \Pi (1, 3, 5, 7, 13, 15)$
Sol:

a)

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

$F' = wx + x'z + xy'z'$
$F = (w' + x') (x + z')(x' + y + z)$

b)

| AB\CD | 00 | 01 | 11 | 10 |
|-------|----|----|----|----|
| 00 | | 0 | 0 | |
| 01 | | 0 | 0 | |
| 11 | | 0 | 0 | |
| 10 | | | | |

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

4) Simplify the following expressions in (1) sum-of-products and (2) products-of-sums:
a) $x'z' + y'z' + yz' + xy$
b) $AC' + B'D + A'CD + ABCD$
c) $(A' + B' + D') (A + B' + C') (A'+ B + D')(B+ C' + D')$
Sol:

a)

| x\yz | 00 | 01 | 11 | 10 |
|------|----|----|----|----|
| 0 | 1 | 0 | 0 | 1 |
| 1 | 1 | 0 | 1 | 1 |

$F = xy + z' = (x+z')(y+z')$

b)

| AB\CD | 00 | 01 | 11 | 10 |
|-------|----|----|----|----|
| 00 | 0 | 1 | 1 | 0 |
| 01 | 0 | 0 | 1 | 0 |
| 11 | 1 | 1 | 1 | 0 |
| 10 | 1 | 1 | 1 | 0 |

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

c)

| AB\CD | 00 | 01 | 11 | 10 |
|-------|----|----|----|----|
| 00 | 1 | 1 | 0 | 1 |
| 01 | 1 | 1 | 0 | 0 |
| 11 | 1 | 0 | 0 | 1 |
| 10 | 1 | 0 | 0 | 1 |

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

5) Simplify the following Boolean function F, together with the don't-care conditions *d,* and then express the simplified function in **sum of products**:

    a. $F(x,y,z) = \Sigma\ (0,1,2,4,5)$, $d(x,y,z) = \Sigma\ (3,6,7)$

    b. $F(A,B,C,D) = \Sigma\ (1,3,5,7,9,15)$, $d(A,B,C,D) = \Sigma\ (4,6,12,13)$

Sol:

3a

| yz \\ x | 00 | 01 | 11 | 10 |
|---|---|---|---|---|
| 0 | 1 | 1 | X | 1 |
| 1 | 1 | 1 | X | X |

F=1=Σ(0,1,2,3,4,5,6,7)

3b

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

F=A'D+BD+C'D=Σ(1,3,5,7,9,13,15)