1. ① SOP : without don't cares



$$Y = \bar{B}\bar{D} + A\bar{B}\bar{C} + ABCD$$

② SOP : with don't cares



$$Y = \bar{B}\bar{D} + \bar{B}\bar{C} + BCD$$

③ POS : without don't cares



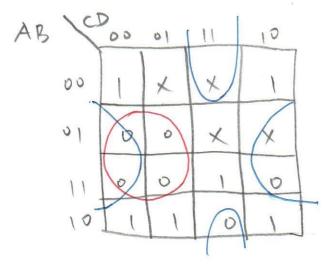$$Y = (\bar{B}+C)(\bar{A}+\bar{B}+D)(\bar{A}+B+\bar{C}+D)$$

POS: with don't cares         



$$Y = (\bar{B} + C)(\bar{B} + D)(B + \bar{C} + \bar{D})$$

## 2. ① Minterms

| 0 | 1 | 2 | 4 | 5 | 6 | 11 | 13 | 15 |
|---|---|---|---|---|---|----|----|----|
| 0000 | 0001 | 0010 | 0100 | 0101 | 0110 | 1011 | 1101 | 1111 |

② Grouping minterms, comparisons, & combinations

| group 0 | 0 | 0000 ✓ |
|---------|---|--------|

| group 1 | 1 | 0001 ✓ |
|---------|---|--------|
|         | 2 | 0010 ✓ |
|         | 4 | 0100 ✓ |

| group 2 | 5 | 0101 ✓ |
|---------|---|--------|
|         | 6 | 0110 ✓ |

| group 3 | 11 | 1011 ✓ |
|---------|----|--------|
|         | 13 | 1101 ✓ |

| group 4 | 15 | 1111 ✓ |
|---------|----|--------|

table 1

| 0,1 | 000− ✓ |
|-----|--------|
| 0,2 | 00−0 ✓ |
| 0,4 | 0−00 ✓ |
| 1,5 | 0−01 ✓ |
| 2,6 | 0−10 ✓ |
| 4,5 | 010− ✓ |
| 4,6 | 01−0 ✓ |
| 5,13 | −101 |
| 11,15 | 1−11 |
| 13,15 | 11−1 |

table 2

| 0,1,4,5 | 0−0− |
|---------|------|
| 0,2,4,6 | 0−−0 |
| 0,4,1,5 | 0−0− |
| 0,4,2,6 | 0−−0 |

redundant

table 3

PIs:

table 2

| 5, 13 | -101 | $B\bar{C}D$ |
| 11, 15 | 1-11 | $ACD$ |
| 13, 15 | 11-1 | $ABD$ |

table 3

| 0,1,4,5 | 0-0- | $\bar{A}\bar{C}$ |
| 0,2,4,6 | 0--0 | $\bar{A}\bar{D}$ |

③ PI chart

| | Index | PI | 0 | 1 | 2 | 4 | 5 | 6 | 11 | 13 | 15 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| PI | 5, 13 | $B\bar{C}D$ | | | | | × | | | × | |
| EPI | 11, 15 | $ACD$ | | | | | | | ⊗ | | × |
| PI | 13, 15 | $ABD$ | | | | | | | | × | × |
| EPI | 0,1,4,5 | $\bar{A}\bar{C}$ | × | ⊗ | | × | × | | | | |
| EPI | 0,2,4,6 | $\bar{A}\bar{D}$ | × | | ⊗ | × | | ⊗ | | | |

$$Y = ACD + \bar{A}\bar{C} + \bar{A}\bar{D} + B\bar{C}D$$

EPI      PI

$$or, \quad Y = ACD + \bar{A}\bar{C} + \bar{A}\bar{D} + ABD$$

EPI      PI