

## ELEC 2200 Section 2 Spring 2012 Assignment #4 Solutions

1. For each of the following logic equations, use Boolean theorems and postulates to obtain a valid SOP expression (1 pt each):

a.  $Z = ((D+(A'B)')(B+C)')'$

$$\begin{aligned} &= (D+AB)(B+C) \quad \text{no change, just easier to work with bars} \\ &= (D+AB)+(B+C) \quad \text{by DeMorgan's theorem} \\ &= (D+AB)+B+C \quad \text{by involution theorem} \\ &= (D \cdot AB)+B+C \quad \text{by DeMorgan's theorem} \\ &= (D \cdot AB)+B+C \quad \text{by involution theorem} \\ &= ABD+B+C \quad \text{by commutativity postulate} \\ &\quad \text{This is a valid SOP} \end{aligned}$$

b.  $A = (((X'Y)'Z)'+W)'$

$$\begin{aligned} &= XYZ+W \quad \text{no change, just easier to work with bars} \\ &= XYZ \cdot W \quad \text{by DeMorgan's theorem} \\ &= \overline{XYZ} \cdot W \quad \text{by involution theorem} \\ &= (X+Y)ZW \quad \text{by DeMorgan's theorem} \\ &= (X+Y)ZW \quad \text{by involution theorem} \\ &= WXZ+WYZ \quad \text{by involution theorem} \\ &\quad \text{This is a valid SOP} \end{aligned}$$

2. For the following minterm/maxterm representations, obtain the complete truth table showing minterm values (1 pt each)

a.  $Z(A,B,C) = \sum m(3,5,6,7)$

| dec | A B C | Z |
|-----|-------|---|
| 0   | 0 0 0 | 0 |
| 1   | 0 0 1 | 0 |
| 2   | 0 1 0 | 0 |
| 3   | 0 1 1 | 1 |
| 4   | 1 0 0 | 0 |
| 5   | 1 0 1 | 1 |
| 6   | 1 1 0 | 1 |
| 7   | 1 1 1 | 1 |

b.  $X(H,I,J,K) = \prod M(0,12,13,15)$

| dec | H I J K | X |
|-----|---------|---|
| 0   | 0 0 0 0 | 0 |
| 1   | 0 0 0 1 | 1 |
| 2   | 0 0 1 0 | 1 |
| 3   | 0 0 1 1 | 1 |
| 4   | 0 1 0 0 | 1 |
| 5   | 0 1 0 1 | 1 |
| 6   | 0 1 1 0 | 1 |
| 7   | 0 1 1 1 | 1 |
| 8   | 1 0 0 0 | 1 |
| 9   | 1 0 0 1 | 1 |
| 10  | 1 0 1 0 | 1 |
| 11  | 1 0 1 1 | 1 |
| 12  | 1 1 0 0 | 0 |
| 13  | 1 1 0 1 | 0 |
| 14  | 1 1 1 0 | 1 |
| 15  | 1 1 1 1 | 0 |

3. For the following truth table, obtain (1 pt each):

| X Y Z | M |
|-------|---|
| 0 0 0 | 0 |
| 0 0 1 | 1 |
| 0 1 0 | 1 |
| 0 1 1 | 0 |
| 1 0 0 | 1 |
| 1 0 1 | 0 |
| 1 1 0 | 0 |
| 1 1 1 | 1 |

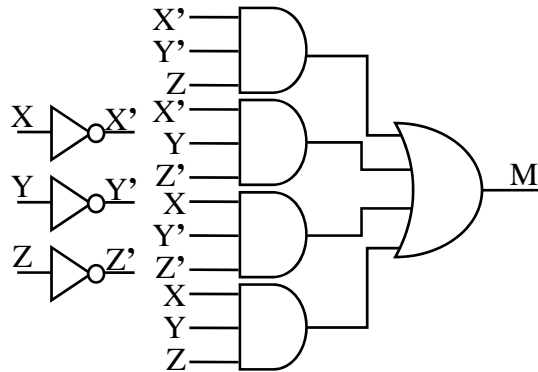
a. canonical form SOP

$$M = X'Y'Z + X'YZ' + XY'Z' + XYZ$$

b. minterm representation

$$M(X,Y,Z) = \sum m(1,2,4,7)$$

c. draw the 2-level AND-OR implementation



d. canonical form POS

$$M = (X+Y+Z) \cdot (X+Y'+Z') \cdot (X'+Y+Z') \cdot (X'+Y'+Z)$$

e. maxterm representation

$$M(X,Y,Z) = \prod M(0,3,5,6)$$

f. draw the 2-level OR-AND implementation

