

HOMEWORK #1□ WRITTEN

1.) Use Boolean Algebra to prove that

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

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

$$= (A+B)(B+C)$$

$$B + (A\bar{B}C)$$

$$= (A+B)(B+C)$$

$$B + \bar{B}(AC)$$

$$= B + (AC)$$

B

$$B + AC$$

$$= B + AC$$

$$\text{LHS} = \text{RHS} \checkmark$$

 $\therefore$  equivalent2.) Prove that  $A \text{ XOR } B = A * \bar{B} + \bar{A} * B$  $\rightarrow$  Truth Table

A	B	$\bar{A}$	$\bar{B}$	$A * \bar{B}$	$\bar{A} * B$	$A * \bar{B} + \bar{A} * B$	$A \oplus B$
0	0	1	1	0	0	0	0
0	1	1	0	0	1	1	1
1	0	0	1	1	0	1	1
1	1	0	0	0	0	0	0

$\nwarrow$  tautology  $\approx$  equivalent  $\nearrow$

XOR ( $\oplus$ ) = cannot be same

$$\text{i.e.: } 0 \oplus 0 = 0 \quad 1 \oplus 0 = 1$$

$$0 \oplus 1 = 1 \quad 1 \oplus 1 = 0$$

$$\therefore A \text{ XOR } B = A * \bar{B} + \bar{A} * B$$

via truth table  $\checkmark$ 

3.) Write function that represents following circuit. Do not simplify

$$(AB\bar{C}) + [\bar{D}(AB\bar{C})] + ((AB\bar{C})' D)] * (\bar{A}D) + (\bar{D}+B) \text{ (simplified)}$$

$$f(x) = [(AB\bar{C}) \oplus D * (\bar{A}D)] + (\bar{D}+B) = F$$

$$AB\bar{C} \text{ XOR } D * \text{NOT}(AD) + (\bar{D}+B) = F$$



4.) Given the following truth table.

4.1) Write function in SOP form. Do not simplify.

SOP = sum of products, minterms

• want all 1's output

$$= m_0 + m_1 + m_2 + m_5 + m_6$$

where:  $m_0 = (\bar{A}\bar{B}\bar{C})$        $m_5 = (A\bar{B}C)$

$m_1 = (\bar{A}\bar{B}C)$        $m_6 = (AB\bar{C})$

$m_2 = (\bar{A}B\bar{C})$

so:

$$f(x) = (\bar{A}\bar{B}\bar{C}) + (\bar{A}\bar{B}C) + (\bar{A}B\bar{C}) + (A\bar{B}C) + (AB\bar{C})$$

4.2) Write function in POS form. Do not simplify.

POS = product of sums, maxterms

• want all 0's output

$$= M_3 + M_4 + M_7$$

where:  $M_3 = (A + \bar{B} + \bar{C})$

$M_4 = (\bar{A} + B + C)$

$M_7 = (\bar{A} + \bar{B} + \bar{C})$

so:

$$f(x) = (A + \bar{B} + \bar{C}) * (\bar{A} + B + C) * (\bar{A} + \bar{B} + \bar{C})$$

5.) most simplified SOP & POS form for ea. of the functions.

5.1)  $m_0 + m_1 + m_2$

$x_0 \backslash x_1$	0	1
0	1 <sub>0</sub>	1 <sub>2</sub>
1	1 <sub>1</sub>	0 <sub>3</sub>

SOP =  $(\bar{x}_1 * \bar{x}_0)$

POS =  $(\bar{x}_1 + \bar{x}_0)$

5.2)  $M_0 * M_3 * M_4 * M_7$

$x_0 \backslash x_1$	00	01	11	10
0	0 <sub>0</sub>	1 <sub>2</sub>	1 <sub>6</sub>	0 <sub>4</sub>
1	1 <sub>1</sub>	0 <sub>3</sub>	0 <sub>7</sub>	1 <sub>5</sub>

SOP =  $(x_1 * \bar{x}_0) + (\bar{x}_1 * x_0)$

POS =  $(x_1 + x_0) * (\bar{x}_1 + x_0)$



5.3)  $m_4 + m_5 + m_7 + m_{12} + m_{13} + m_{15}$

$2^4 = 16$

$x_3 \backslash x_2$ $x_1 \backslash x_0$	00	01	11	10
00	0	1 <sub>4</sub>	1 <sub>12</sub>	0 <sub>8</sub>
01	0	1 <sub>5</sub>	1 <sub>13</sub>	0 <sub>9</sub>
11	0	1 <sub>7</sub>	1 <sub>15</sub>	0 <sub>11</sub>
10	0	0 <sub>6</sub>	0 <sub>14</sub>	0 <sub>10</sub>

SOP =  $(x_0 * x_2) + (\bar{x}_1 * x_2)$

POS =  $x_2 * (\bar{x}_1 + x_0)$

• POS is SOP essentially but,  
product of sums w/  
 $x_2$  factored out

5.4)  $m_0 + m_3 + m_4 + m_8 + D_2 + D_5 + D_7 + D_{10} + D_{13} + D_{15}$

$x_3 \backslash x_2$ $x_1 \backslash x_0$	00	01	11	10
00	1 <sub>0</sub>	1 <sub>4</sub>	0 <sub>12</sub>	1 <sub>6</sub>
01	0 <sub>1</sub>	DC <sub>5</sub>	DC <sub>13</sub>	0 <sub>9</sub>
11	1 <sub>3</sub>	DC <sub>7</sub>	DC <sub>15</sub>	0 <sub>11</sub>
10	DC <sub>2</sub>	0 <sub>6</sub>	0 <sub>14</sub>	DC <sub>10</sub>

SOP =  $(\bar{x}_0 * \bar{x}_2) + (\bar{x}_3 * \bar{x}_1 * \bar{x}_0) +$   
 $(\bar{x}_3 * \bar{x}_2 * x_1)$

POS =  $(\bar{x}_2 + \bar{x}_3) * (\bar{x}_0 + x_1) *$   
 $(\bar{x}_3 + \bar{x}_0) * (\bar{x}_2 + \bar{x}_1)$

5.5)  $m_1 + m_3 + m_7 + m_9 + m_{11} + m_{15} + m_{17} + m_{19} + m_{25} + m_{27} + D_4 + D_6 +$   
 $D_{12} + D_{14} + D_{16} + D_{18} + D_{20} + D_{22} + D_{24} + D_{26} + D_{28} + D_{30}$

$x_3 \backslash x_2$ $x_1 \backslash x_0$	00	01	11	10
00	0 <sub>0</sub>	DC <sub>4</sub>	DC <sub>12</sub>	0 <sub>8</sub>
01	1 <sub>1</sub>	0 <sub>5</sub>	0 <sub>13</sub>	1 <sub>9</sub>
11	1 <sub>3</sub>	1 <sub>7</sub>	1 <sub>15</sub>	1 <sub>11</sub>
10	0 <sub>2</sub>	DC <sub>6</sub>	DC <sub>14</sub>	0 <sub>10</sub>
00	DC <sub>16</sub>	DC <sub>20</sub>	DC <sub>28</sub>	DC <sub>24</sub>
01	1 <sub>17</sub>	0 <sub>21</sub>	0 <sub>29</sub>	1 <sub>25</sub>
11	1 <sub>19</sub>	0 <sub>23</sub>	0 <sub>31</sub>	1 <sub>27</sub>
10	DC <sub>18</sub>	DC <sub>22</sub>	DC <sub>30</sub>	DC <sub>26</sub>

SOP =  $(x_0 * \bar{x}_2) + (x_2)$

POS =  $(\bar{x}_2 + x_1) * (x_2 + \bar{x}_1)$   
 $* (\bar{x}_2 + \bar{x}_0)$