# MAD 3105 PRACTICE FOR FINAL EXAM
# SOLUTIONS

## 1. Boolean Algebra

(36) Define the Boolean function, $F$, in the three variables, $x$, $y$, and $z$, by $F(1,1,0) = F(1,0,1) = F(0,0,0) = 1$ and $F(x,y,z) = 0$ for all other $(x,y,z)$ in $\{0,1\}^3$.

(a) Find the sum-of-products form for $F$.

$$F(x,y,z) = xy\overline{z} + x\overline{y}z + \overline{x}\,\overline{y}\,\overline{z}$$

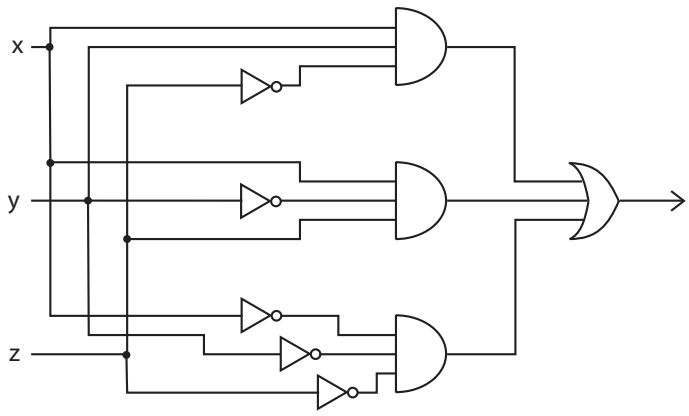
(b) Find the product-of-sums form for $F$.

$$F(x,y,z) = (\overline{x}+\overline{y}+\overline{z})(x+\overline{y}+\overline{z})(\overline{x}+y+z)(x+\overline{y}+z)(x+y+\overline{z})$$

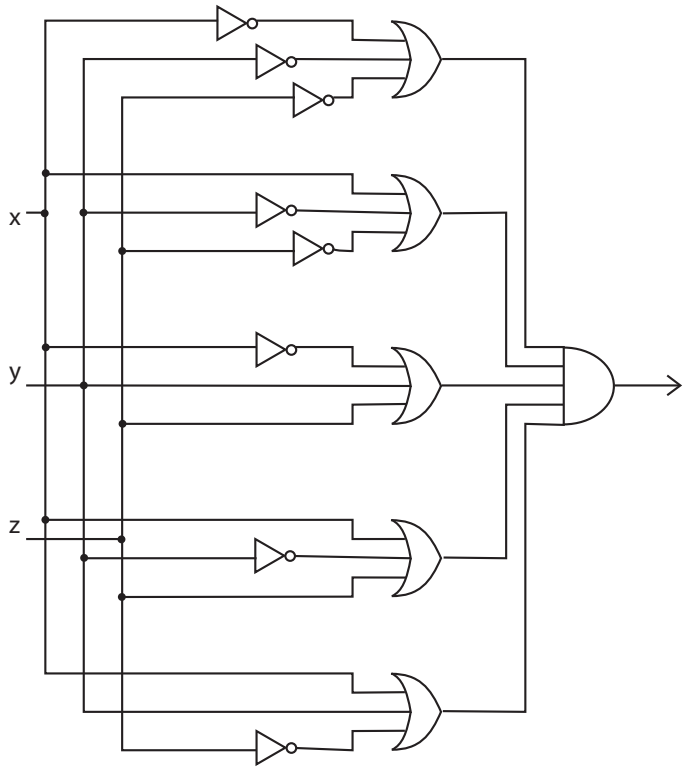
(c) Find the dual of the expression in ?a.

$$F^d(x,y,z) = (x+y+\overline{z})(x+\overline{y}+z)(\overline{x}+\overline{y}+\overline{z})$$

(d) Sketch the logical network that has the same output as $F$, and uses the order of operations given in the expression in part (a).

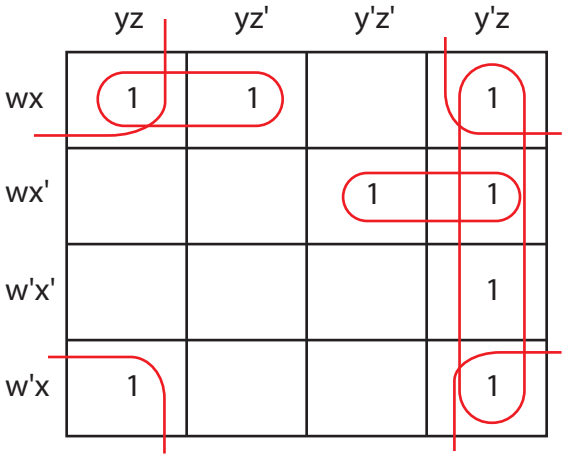



(e) Sketch the logical network that has the same output as $F$, and uses the order of operations given in the expression in part (b).




(48) Use (a) Karnaugh maps and (b) the Quine McClusky method to find a minimal expansion for $wxyz + wxy\overline{z} + wx\overline{y}z + w\overline{x}\,\overline{y}z + w\overline{x}\,\overline{y}\,\overline{z} + \overline{w}x\overline{y}z + \overline{w}xyz + \overline{w}\,\overline{x}\,\overline{y}z$

(a)




$$xz + y'z + wxy + wx'y'$$

(b)

| | | | |
|---|---|---|---|
| 1 | $wxyz$ | 1111 | 4 |
| 2 | $wxyz'$ | 1110 | 3 |
| 3 | $wxy'z$ | 1101 | 3 |
| 4 | $wx'y'z$ | 1001 | 2 |
| 5 | $wx'y'z'$ | 1000 | 1 |
| 6 | $w'xy'z$ | 0101 | 2 |
| 7 | $w'xyz$ | 0111 | 3 |
| 8 | $w'x'y'z$ | 0001 | 1 |

| | | |
|---|---|---|
| $(1,2)$ | $wxy$ | $111-$ |
| $(1,3)$ | $wxz$ | $11-1$ |
| $(1,7)$ | $xyz$ | $-111$ |
| $(3,4)$ | $wy'z$ | $0-01$ |
| $(3,6)$ | $xy'z$ | $-101$ |
| $(4,5)$ | $wx'y'$ | $100-$ |
| $(4,8)$ | $x'y'z$ | $-001$ |
| $(6,7)$ | $w'xz$ | $01-1$ |
| $(6,8)$ | $w'y'z$ | $0-01$ |

| | | |
|---|---|---|
| $(1,3,6,7)$ | $xz$ | $-1-1$ |
| $(3,4,6,8)$ | $y'z$ | $--01$ |

$$xz + y'z + wxy + wx'y'$$

The solutions to the remaining problems may be found on a previous review.