EE200 DIGITAL LOGIC CIRCUIT DESIGN

The material covered in this class will be as follows:

- ⇒Boolean functions
- ⇒Algebraic manipulation
- ⇒Complement of a function
- ⇒Canonical and standard forms

Boolean Functions

The following Boolean functions are represented in the truth table.

$F_1 = xyz'$

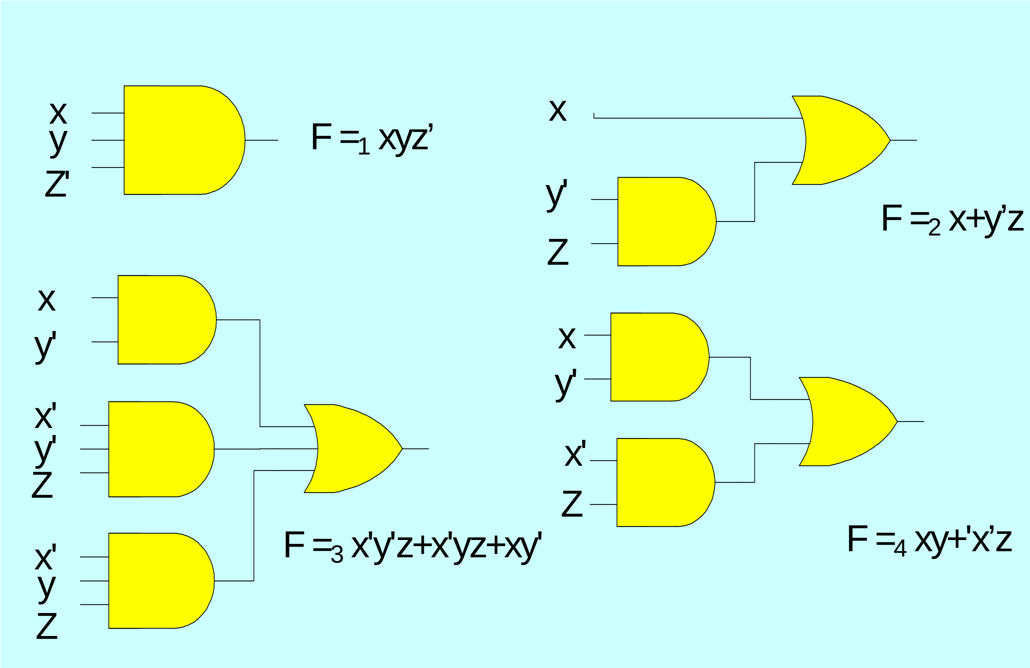
$F_2 = x + y'z$

$F_3 = x'y'z + x'yz + xy'$

$F_4 = xy' + x'z$

x	y	z	F_1	F_2	F_3	F_4
0	0	0	0	0	0	0
0	0	1	0	1	1	1
0	1	0	0	0	0	0
0	1	1	0	0	1	1
1	0	0	0	1	1	1
1	0	1	0	1	1	1
1	1	0	1	1	0	0
1	1	1	0	1	0	0

The functions can be implemented, using the basic logic gates, as shown in the following logic diagrams.



Algebraic Manipulation

Boolean functions are made up of terms. Each term consists of a number of literals. A literal is a variable or the complement of a variable. Each term is represented by a logic gate and each literal represents an input to a logic gate. By reducing the number of terms, the number of literals, or both, a simpler logic circuit can be used to implement the Boolean function.

Reduction of the number of terms and/or number of literals is done by algebraic manipulation.

Examples

1. $x(x'+y) = xx'+xy = 0+xy = xy$

2. The dual of (1) is →
$x+x'y = (x+x')(x+y) = 1.(x+y) = x+y$

3. $(x+y)(x+y')=x+yy'=x+0=x$

4. $$\begin{aligned} xy+x'z+yz &= xy+x'z+(x+x')yz \\ &= xy+xyz+x'z+x'yz \\ &= xy(1+z)+x'z(1+y) \\ &= xy.1+x'z.1 = xy+x'z \end{aligned}$$

5. $(x+y)(x'+z)(y+z)=(x+y)(x'+z)$ → by duality.

Complement of a Function

The complement of a Boolean function may be obtained by either one of two methods:

1. Repetitive application of DeMorgan's theorem.
2. Taking the dual of the function and complementing each literal.

Example:

Find the complement of $F = x'yz' + x'y'z$

First method $$\begin{aligned} F' &= (x'yz' + x'y'z)' = (x'yz')'.(x'y'z)' \\ &= (x+y'+z)(x+y+z') \end{aligned}$$

Second method

dual of F → $F^{dual} = (x'+y+z')(x'+y'+z)$

then complement each literal

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

Canonical and Standard Forms

Minterms and Maxterms

			Minterms		Maxterms	
x	y	z	Term	Designation	Term	Designation
0	0	0	$x'y'z'$	m_0	$x+y+z$	M_0
0	0	1	$x'y'z$	m_1	$x+y+z'$	M_1
0	1	0	$x'yz'$	m_2	$x+y'+z$	M_2
0	1	1	$x'yz$	m_3	$x+y'+z'$	M_3
1	0	0	$xy'z'$	m_4	$x'+y+z$	M_4
1	0	1	$xy'z$	m_5	$x'+y+z'$	M_5
1	1	0	xyz'	m_6	$x'+y'+z$	M_6
1	1	1	xyz	m_7	$x'+y'+z'$	M_7