ECE213: Digital Electronics

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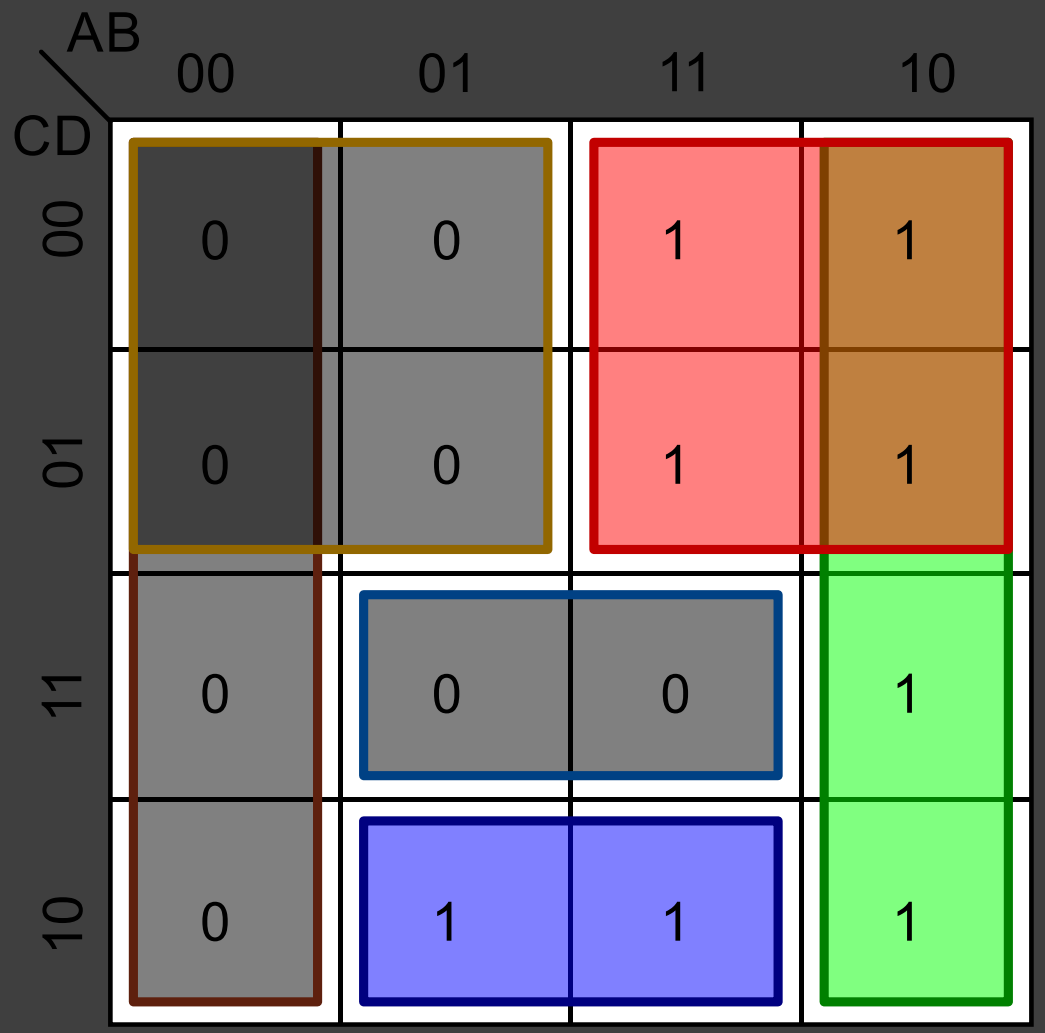
The Course Contents

Unit II

Combinational Logic System : Truth table, Basic logic operation, Boolean Algebra, Basic postulates, Standard representation of logic functions -SOP forms, Simplification of switching functions - K-map, Synthesis of combinational logic circuits, Logic gates, Fundamental theorems of Boolean algebra, Standard representation of logic functions POS forms

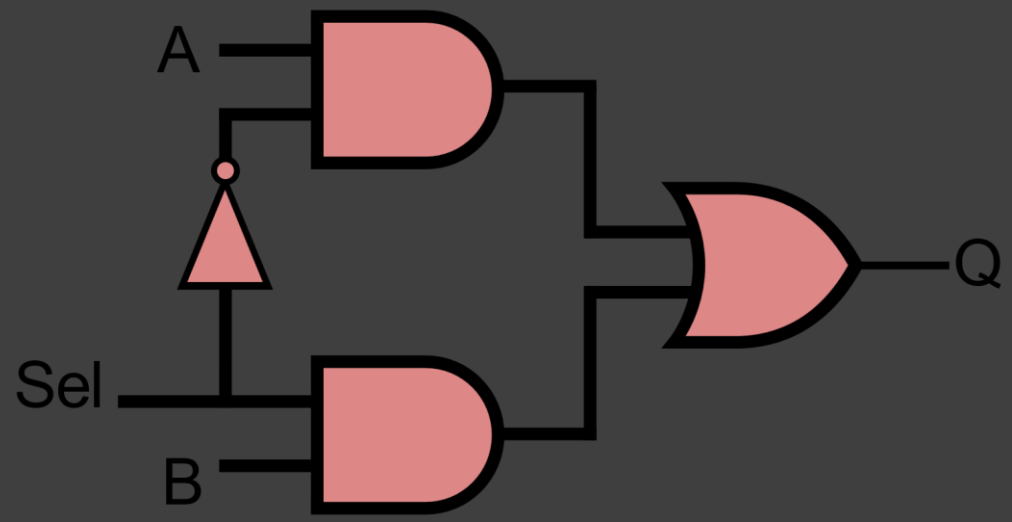


The Course Contents

Unit III

Introduction to Combinational Logic Circuits : Adders, Subtractors, Comparators, Multiplexers and Demultiplexers, Decoders, Encoders, Parity circuits

Introduction to Logic Families : Introduction to different logic families, Structure and operations of TTL, MOS and CMOS logic families



Combinational Logic System

Standard representation of logic functions

SOP / POS / Minterm / Maxterm forms

Sum of Products

Product of Sums

Note: Write Variable for 1
Write $\overline{\text{Variable}}$ for 0

Step 1: Define logic
Step 2: Make TT
Step 3: ——

Write Variable for 0
Write $\overline{\text{Variable}}$ for 1

Ex AND Logic

	A	B	Y
0	0	0	0
1	0	1	0
2	1	0	0
3	1	1	1

SOP

$Y = AB$

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

→ POS

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

Minterm

$Y = \sum m(3)$

→ Maxterm

$Y = \prod M(0,1,2)$

Combinational Logic System

we can't change it

Standard representation of logic functions

SOP / POS / Minterm / Maxterm forms

for SOP: write variable for 1, with bar for 0

for POS: write var for 0, with bar for 1

Ex 2-input XOR Gate-

	A	B	Y
0	0	0	0
1	0	1	1
2	1	0	1
3	1	1	0

SOP

$$Y = \bar{A}B + A\bar{B}$$

POS

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

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

Minterm

$$Y = \sum m(1,2)$$

Maxterm

$$= Y = \prod M(0,3)$$

Note: Minterm: are those terms which are responsible for high o/p.
Maxterm are the term which are responsible for low o/p.

Combinational Logic System

Canonical

Standard representation of logic functions

SOP / POS / Minterm / Maxterm forms

Ex Sum of full adder

	A	B	C	Y
0	0	0	0	0
1	0	0	1	1
2	0	1	0	1
3	0	1	1	0
4	1	0	0	1
5	1	0	1	0
6	1	1	0	0
7	1	1	1	1

SoP

$$Y = \bar{A}\bar{B}C + \bar{A}B\bar{C} + A\bar{B}\bar{C} + ABC$$

Minterm

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

PoS

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

Maxterm

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

Combinational Logic System

Standard representation of logic functions -SOP / POS forms

Which of the following is an incorrect SOP expression?

a) x+x.y SOP

b) (x+y)(x+z) POS

c) x SOP

d) x+y SOP

Combinational Logic System

Standard representation of logic functions

SOP / POS / Minterm / Maxterm forms

★ Standard → means, that each term should include all the input variables

Ex Find the standard SOP and POS form of following Boolean eqn

$$Y = A + BC$$

Stand Minterm

$$Y = \sum m(3,4,5,6,7)$$

How to express?

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

$$= (AB + A\bar{B})(C+\bar{C}) + ABC + \bar{A}BC$$

$$= ABC + AB\bar{C} + A\bar{B}C + A\bar{B}\bar{C} + ABC + \bar{A}BC$$

1 1 1	1 1 0	1 0 1	1 0 0	1 1 1	0 1 1
7	6	5	4	7	3

Stand SOP

$$\boxed{Y = \bar{A}BC + A\bar{B}\bar{C} + A\bar{B}C + AB\bar{C} + ABC}$$

Combinational Logic System

Standard representation of logic functions

SOP / POS / Minterm / Maxterm forms

$\Rightarrow Y = \sum m(3,4,5,6,7)$

$Y = \prod M(0,1,2)$

POS

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

0 — 7

0 — 15

0 — 31

Combinational Logic System

Standard representation of logic functions

SOP / POS / Minterm / Maxterm forms

Ex $Y = S\bar{T} + SU$ Sol

	S	T	U	Y
0	0	0	0	0
1	0	0	1	0
2	0	1	0	0
3	0	1	1	0
4	1	0	0	1
5	1	0	1	1
6	1	1	0	0
7	1	1	1	1

Sol $Y = S\bar{T}\bar{U} + S\bar{T}U + STU$

$$Y = \sum m(4,5,7)$$

POS $Y = (S+T+U)(S+T+\bar{U})(S+\bar{T}+U)(S+\bar{T}+\bar{U})(\bar{S}+\bar{T}+U)$

$$Y = \prod M(0,1,2,3,6)$$