2025

PES UNIVERSITY

Dept. of Electronics and Communication Engineering

UE25EC141A - Electronic Principles and Devices (4-0-0-4-4)

Question and Answers

UNIT- 4: Digital Electronics

1) **Convert $(1010.01)_2$ to decimal.**
$1x2^3 + 0x2^2 + 1x2^1 + 0x2^0 + 0x2^{-1} + 1x2^{-2} = 8+0+2+0+0+0.25 = 10.25$
(1010.01)2 = $(10.25)_{10}$

2) **Convert $(725)_{10}$ to hexadecimal.**

16	725
16	45
	2

5	5
13	D
2	2

$(725)_{10}$=$(2D5)_{16}$

3) **Subtract $(11101)_2$ from $(10110)_2$ using 2's complement method.**
Let A= $(10110)_2$, B= $(11101)_2$, A-B=?
2's complement of B=11101 is 00011

$$\begin{array}{cccccc} & & 1 & 1 & & \\ & 1 & 0 & 1 & 1 & 0 \\ + & 0 & 0 & 0 & 1 & 1 \\ \hline & 1 & 1 & 0 & 0 & 1 \end{array}$$

Here there is no carry, answer is - (2's complement of the sum obtained 11001)
So answer is **-00111**

4) **State and prove De Morgan's theorem.**

(i) The complement of the sum of 2 variables is equal to the product of the complements of individual variables: $\overline{A+B} = \overline{A}.\overline{B}$

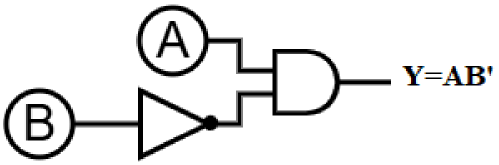
(ii) The complement of the product of 2 variables is equal to the sum of the complements of individual variables: $\overline{A.B} = \overline{A} + \overline{B}$

A	B	$\overline{A}$	$\overline{B}$	$A+B$	$A.B$	$\overline{A+B}$	$\overline{A}.\overline{B}$	$\overline{A.B}$	$\overline{A}+\overline{B}$
0	0	1	1	0	0	1	1	1	1
0	1	1	0	1	0	0	0	1	1
1	0	0	1	1	0	0	0	1	1
1	1	0	0	1	1	0	0	0	0

5. Simplify and realize the given Boolean expression using basic gates.
$Y=(A'B+A'+AB)'$

$Y=(A'B)'.\ A''.\ (AB)'$
$=(A''+B')\ A\ (A'+B')$:From De Morgan's theorem
$=(A+B')\ A\ (A'+B')$: $A''=A$
$=(AA+AB')\ (A'+B')$: $AA=A$
$=(A+AB')\ (A'+B')$
$=A(1+B')\ (A'+B')$: $(1+B')=1$
$=A(A'+B')$
$=AA'+AB'$: $AA'=0$
$Y=AB'$

Realization using basic gates



6. Simplify the following Boolean expressions to a minimum number of literals:
i) $abc + a'b + abc'$ ii) $(u + v)(u + v')$ iii) $(a + b + c)(a b + c)$

Solution: i) $abc +$ **$a'b+$** abc'
$= ab(c+c') +$ **$a'b$** **(since** $c+c'$**=1)**
$= ab + a'b$
$= b(a + a') = b(1) = b$

ii) **$(u + v)(u + v') = uu+uv'+uv+vv'$**
$uu = u$
$vv' = 0$
$= u+uv'+uv+0$
$=u(1+v'+v)$
Since $v' + v = 1$
$u(1+1)=u(1)=u$

iii) **$(a + b + c)(a b + c)$**
$=(a+b+c)(ab)+(a+b+c)(c)$
We'll simplify each part:
$=(a+b+c)(ab)=a\cdot ab+b\cdot ab+c\cdot ab$
$=aab+bab+cab$
$=a\cdot a\cdot b+b\cdot a\cdot b+c\cdot a\cdot b$
$(a+b+c)(ab)=ab+ab+abc=ab+abc$

Another Term: $(a + b + c)(c)$
$=(a+b+c)(c)=a\cdot c+b\cdot c+c\cdot c=ac+bc+c$

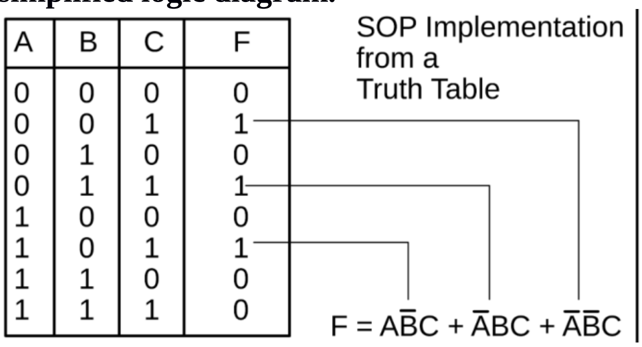
=ac+bc+c=c(ac+bc+1)=c(1)=c

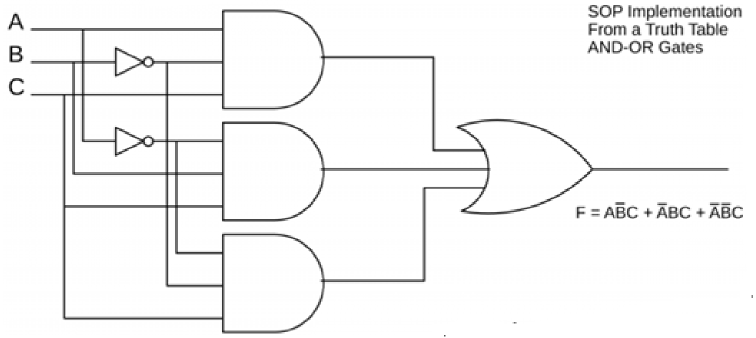
Now combine: (a+b+c)(ab+c)=ab+c

7. Draw the logic circuit diagrams for both the original and the simplified expressions of the Boolean function with the help of truth table:

Y= F=A′BC+A′BC+A′BC′

.b) Simplify the expression to the minimum number of literals and draw the corresponding simplified logic diagram.





b)Use identities:

- A′B+AB′=A⨁B

F=C(A⨁B)+ABC′

3. i) Prove (x+y) (x+z) = x + yz

(i) xy + xz + yz' = xz + yz'

(ii) Simplify F = ABCD + ABCD'

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i)    = (x+y) (x+z)
       = (x.x) + (x.z) + (y.x) + (y.z)
       = x + xz + yx + yz                [as x.x = x]
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       = x(1 + z + y) + yz
       = x + yz                         [since 1 + k = 1]
ii)   = xy + xz + yz'
       = xy(z+z') + xz(y+y') + yz'(x+x')     [as x+x' = 1]
       = xyz + xyz' + xyz + xy'z + xyz' + x'yz'
       = xyz + xyz' + xy'z + x'yz'           [as xyz + xyz = xyz]
       = xyz + xy'z + xyz' + x'yz'           [rearranging]
       = xz(y+y') + yz'(x+x')
       = xz + yz'                            [as y+y' = 1]
iii)  = ABCD + ABCD'
       = ABC(D+D')
       = ABC      [as D+D' = 1]
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8. Simply the minterms F(A,B,C)=∑ (0,2,4,6)

$$F = \bar{A}\bar{B}\bar{C} + \bar{A}B\bar{C} + A\bar{B}\bar{C} + AB\bar{C}$$

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

$$F = \bar{B}\bar{C} + B\bar{C} \qquad [\bar{A} + A = 1]$$

$$F = \bar{C}(\bar{B} + B)$$

$$F = \bar{C} \qquad [B + \bar{B} = 1]$$

9. Convert the Boolean function to canonical form F=AC+AB'+B

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

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

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

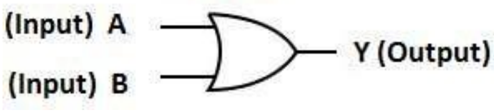
$$F = m_2 + m_3 + m_4 + m_5 + m_6 + m_7$$

$$F(A, B, C) = \sum(2, 3, 4, 5, 6, 7)$$

10. Define Logic Gate. With Truth Table explain OR and AND Logic Solution:

Logic gates are the basic building blocks of any digital system. It is an electronic **circuit** having one or more than one input and only one output. The relationship between the input and the output is based on certain **logic**. Based on this, **logic gates** are named as AND **gate**, OR **gate**, NOT **gate** etc.

Symbol



Truth Table

Inputs		Output
A	B	Y
0	0	0
0	1	1
1	0	1
1	1	1

AND Logic

Symbol

Truth Table

Inputs		Output
A	B	Y
0	0	0
0	1	0
1	0	0
1	1	1

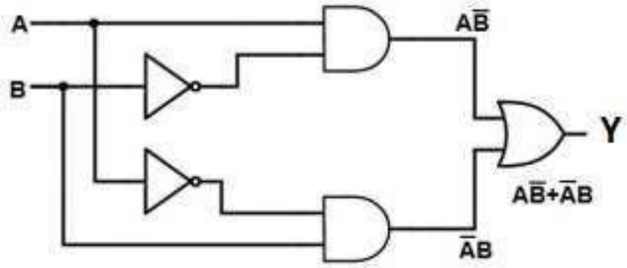
11. State Demorgan's Law and Prove using Truth Table

(i) The complement of the sum of 2 variables is equal to the product of the complements of individual variables.

(ii)The complement of the product of 2 variables is equal to the sum of the complements of individual variables:

A	B	$\overline{A}$	$\overline{B}$	$A+B$	$A.B$	$\overline{A+B}$	$\overline{A}\,.\,\overline{B}$	$\overline{A\,.\,B}$	$\overline{A}+\overline{B}$
0	0	1	1	0	0	1	1	1	1
0	1	1	0	1	0	0	0	1	1
1	0	0	1	1	0	0	0	1	1
1	1	0	0	1	1	0	0	0	0

12. Realize XOR Gate using Basic Gates. Solution:



13. Write the Truth table and logic expressions for Sum and Carry for Half adder

x	y	C	S
0	0	0	0
0	1	0	1
1	0	0	1
1	1	1	0

Boolean Expression:
s = x’.y+ x.y’ c = x.y