MMU
MULTIMEDIA UNIVERSITY

TUTORIAL 4

BOOLEAN ALGEBRA AND LOGIC SIMPLIFICATION

(PART II)

PDS0101: INTRODUCTION TO DIGITAL SYSTEMS

TRI 2, 2022-2023

Question 2 : Draw the **LOGIC CIRCUIT** represented by the following expressions

term by term

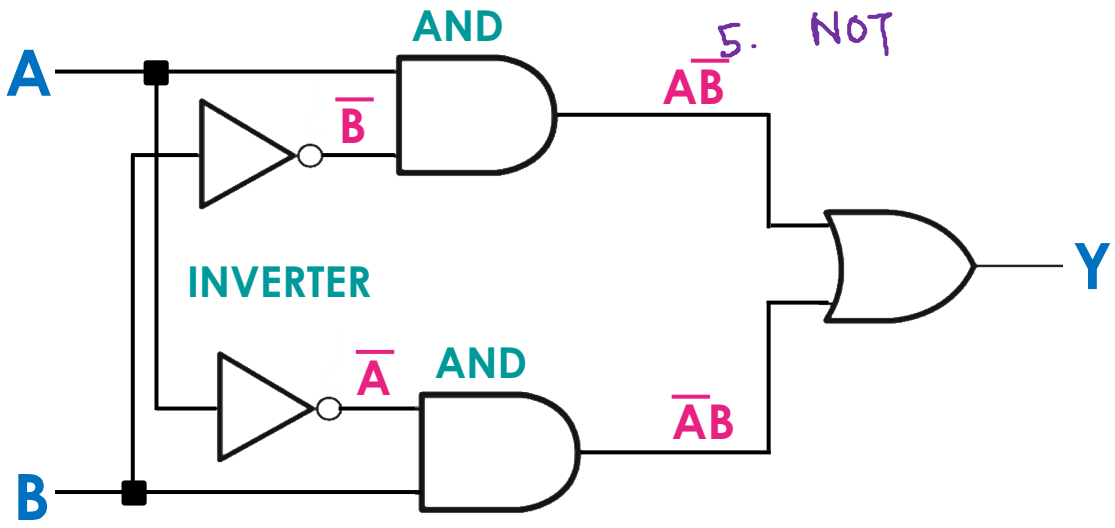
1. ( )
2. negative gate
3. AND gate
4. OR gate
5. NOT

a) $Y = A\overline{B} + \overline{A}B$

INVERTER

AND AND

OR



Question 2 : Draw the **LOGIC CIRCUIT** represented by the following expressions

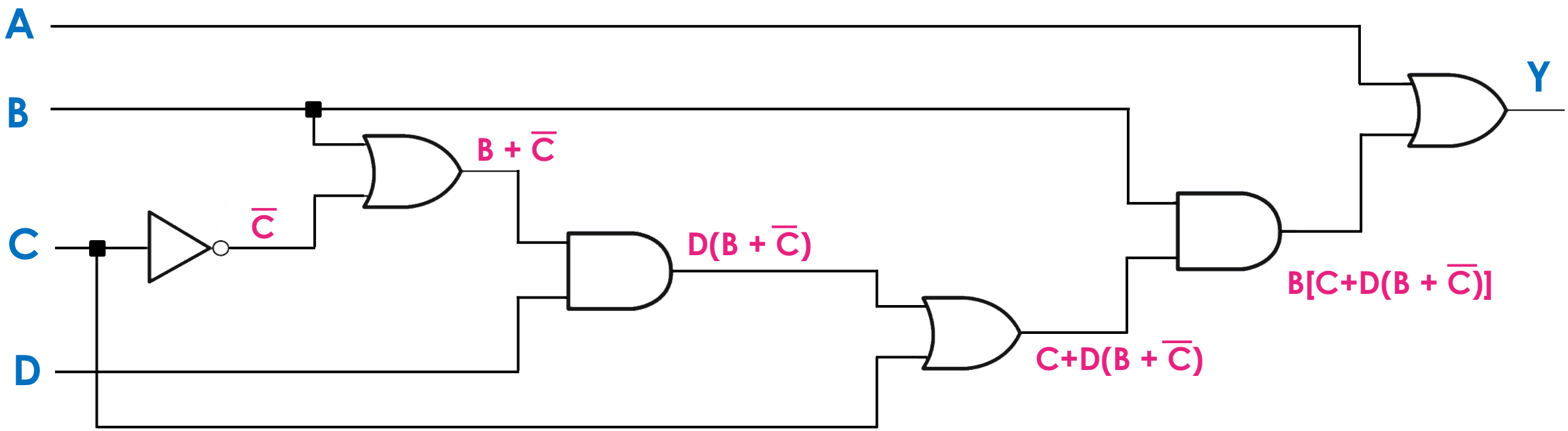
b) $Y = A + B[C + D(B + \overline{C})]$

INVERTER

OR OR AND OR AND

INPUT

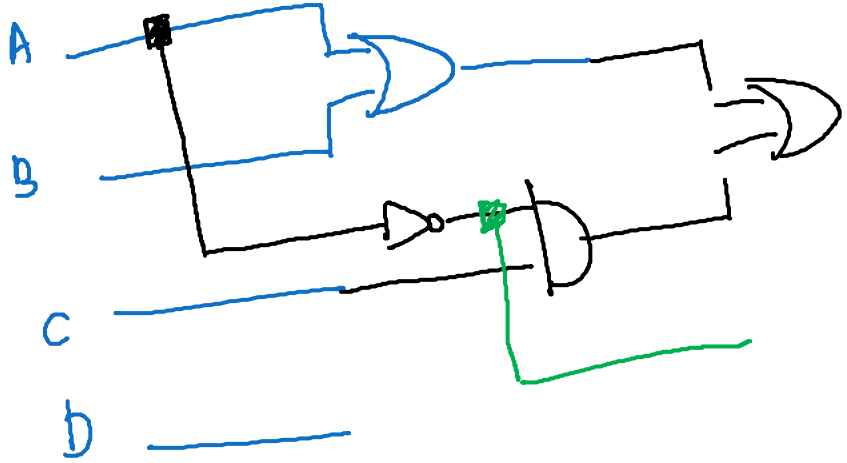
Method 1



drawing logic circuit

method 1

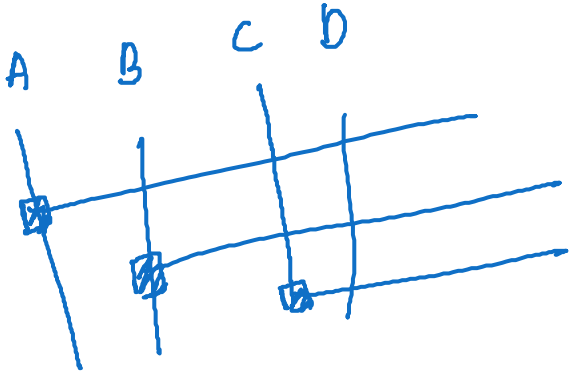
Input using row



method 2

Input using column

connector



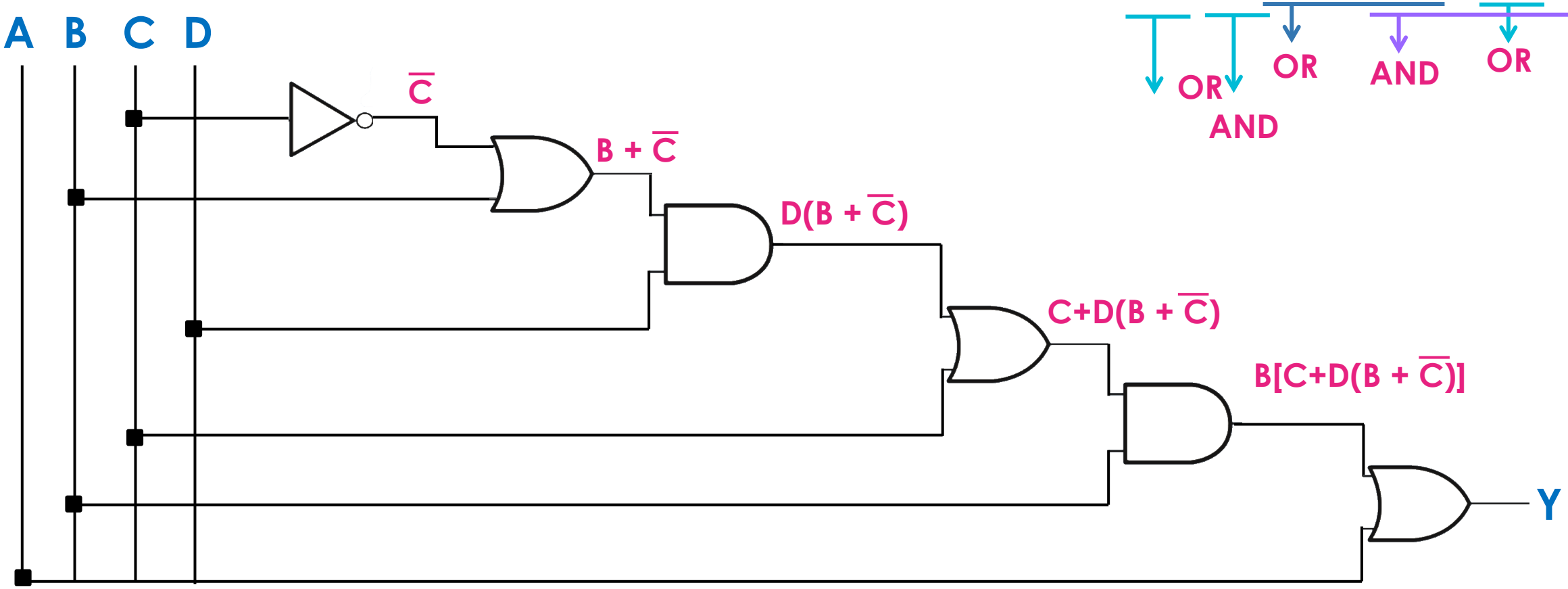
Method 2

$2^4 = 16$ possible input combinations

b) $Y = A + B[C + D(B + \overline{C})]$

INVERTER

OR OR AND OR AND



Question 2(b) : Simplify the given **BOOLEAN EXPRESSIONS**

ADDITIONAL

b) $Y = A + B[C + D(B + \overline{C})]$

$$Y = A + B[C + D(B + \overline{C})]$$
$$= A + B[C + BD + \overline{C}D]$$
$$= A + B(C + D + BD)$$
$$= A + B(C + D)$$
$$= A + BC + BD \quad \ast$$

Rule 11

$A + \overline{A}B = A + B$

$C + \overline{C}D = C + D$

Rule 10

$A + AB = A$

$D + DB = D$

Question 2 : Draw the **LOGIC CIRCUIT** represented by the following expressions

c) $Y = \overline{[(AB + C)D]} + [(CD + B)\overline{A}]$

term x

term y

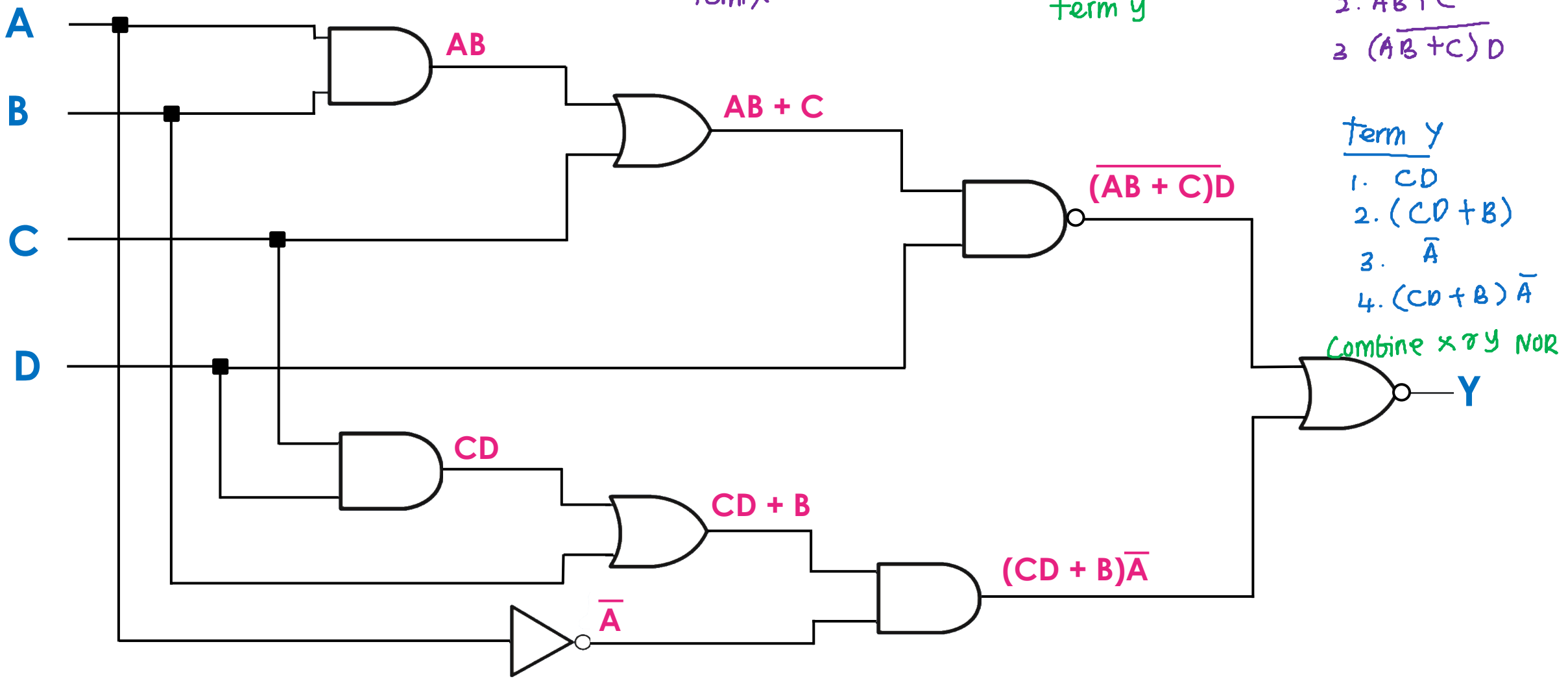
term x

1. AB
2. AB + C
3. $\overline{(AB + C)}D$

term y

1. CD
2. (CD + B)
3. $\overline{A}$
4. $(CD + B)\overline{A}$

Combine x & y NOR



Question 2(c) : Simplify the given BOOLEAN EXPRESSIONS

ADDITIONAL

c) $Y = \overline{[\overline{(AB + C)D}] + [(CD + B)\bar{A}]}$

assume $K = \overline{(AB+C)D}$

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

$= \overline{K + L}$

K NOR L = negative K AND negative L

$\overline{K+L} = \bar{K}\bar{L}$

$= \bar{K}\bar{L}$

$= \left(\overline{\overline{(AB+C)D}}\right)\left(\overline{(CD+B)\bar{A}}\right)$

rule 9

$\bar{\bar{A}} = A$

$(AB+C)D = (AB+C)D$

M NAND $\bar{A}$ = negative M OR negative $\bar{A}$

$= \left((AB+C)D\right)\left(\overline{M\bar{A}}\right)$

$= \left((AB+C)D\right)\left(\bar{M} + \bar{\bar{A}}\right)$

assume $M = CD+B$

CD NOR B = negative CD AND negative B

$= \left((AB+C)D\right)\left(\overline{CD+B} + A\right)$

C NAND D = $\bar{C}$ OR $\bar{D}$

$= \left((AB+C)D\right)\left(\bar{C}\bar{D}(\bar{B}) + A\right)$

rule 1

$A + 0 = A$

rule 8

$A\bar{A} = 0$

rule ?

$AA = A$

rule 3

$A0 = 0$

$= \left((AB+C)D\right)\left(\left[(\bar{C}+\bar{D})\bar{B}\right] + A\right)$

$= (ABD + CD)(\bar{B}\bar{C} + \bar{B}\bar{D} + A)$

$= ABD\bar{B}\bar{C} + ABD\bar{B}\bar{D} + ABDA + CD\bar{B}\bar{C} + CD\bar{B}\bar{D} + CDA$

$= ABD + ACD$ ✗

Question 4 : Apply **DeMorgan's theorems** to following expressions

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

$= \bar{A}B$ ※

A NOR $\bar{B}$ = negative A AND negative $\bar{B}$

$\bar{\bar{B}} = B$

Question 4 : Apply **DeMorgan's theorems** to following expressions

b) $\overline{\overline{A}\,B} = \overline{\overline{A}} + \overline{B}$

$= A + \overline{B}$ ✳

$\overline{A}$ NAND B = negative $\overline{A}$ OR negative B

$\overline{\overline{A}} = A$

Question 4 : Apply **DeMorgan's theorems** to following expressions

c) $\overline{(A + \overline{B} + C + \overline{D})} + \overline{(ABC\overline{D})}$

$= \overline{A}\,\overline{\overline{B}}\,\overline{C}\,\overline{\overline{D}}$

$= \overline{A}\,B\,\overline{C}\,D \; + \; \overline{A} + \overline{B} + \overline{C} + \overline{\overline{D}}$

$= \overline{A}\,B\,\overline{C}\,D + \overline{A} + \overline{B} + \overline{C} + D$ ※

$\overline{A + \overline{B} + C + \overline{D}}$

NOR = negative AND

$\overline{ABC\overline{D}}$

NAND = negative OR

Question 4 : Apply **DeMorgan's theorems** to following expressions

d) $\overline{(A\bar{B}(C+\bar{D}))}$

$= \overline{XY}$

$= \bar{X} + \bar{Y}$

$= \overline{A\bar{B}} + \overline{C+\bar{D}}$

$= \bar{A} + B + \bar{C}D$ ※

X NAND Y = negative X OR negative Y

$X = A\bar{B}$

$Y = C + \bar{D}$

A NAND $\bar{B}$ = negative A OR negative $\bar{B}$

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

$= \bar{A} + B$

C NOR $\bar{D}$ = negative C AND negative $\bar{D}$

$\overline{C+\bar{D}} = \bar{C}\bar{\bar{D}}$

$= \bar{C}D$

Question 4 : Apply **DeMorgan's theorems** to following expressions

NOR = negative AND

e) $\overline{(\overline{A\,B\,C})(\overline{E\,F\,G})+(\overline{H\,I\,J})(\overline{K\,L\,M})}$

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

$= (\overline{ABC})(\overline{EFG})\;\;(\overline{HIJ})(\overline{KLM})$

$= (\overline{ABC})(\overline{EFG})(\overline{HIJ})(\overline{KLM})$

$= (\bar{A}+\bar{B}+\bar{C})(\bar{E}+\bar{F}+\bar{G})(\bar{H}+\bar{I}+\bar{J})(\bar{K}+\bar{L}+\bar{M})$ ※

Question 4 : Apply **DeMorgan's theorems** to following expressions

f) $\overline{\overline{(\overline{A}+\overline{B})(\overline{C}+\overline{D})(\overline{E}+\overline{F})(\overline{G}+\overline{H})}} =$

NOR = negative AND

$(\overline{A}+\overline{B})(\overline{C}+\overline{D})(\overline{E}+\overline{F})(\overline{G}+\overline{H})$

$= (\bar{A}\bar{B})(\bar{C}\bar{D})(\bar{E}\bar{F})(\bar{G}\bar{H})$

$= \bar{A}\bar{B}\bar{C}\bar{D}\bar{E}\bar{F}\bar{G}\bar{H}$ ✳

END DISCUSSION PART II

ANY QUESTIONS ??