

ID# 720456 Jyotiulu HADLARU

N<sub>1</sub>

i) Rise time = 1.0 us

ii) Fall time = 0.8 us

iii) Pulse width = 1.5 us

iv) Amplitude = 10V

N<sub>2</sub>

0 us → 1 us = 1

1 us → 2 us = D

2 us → 3 us = 1

3 us → 4 us = 0

4 us → 5 us = 1

5 us → 6 us = 1

6 us → 7 us = 1

7 us → 8 us = 0

10101110

N<sub>3</sub>

a) baseline = 2V Top pad = 10V

Amplitude = 10V - 2V = 8V

b) vertical divisions = 2 divisions

Vertical control = 1V/div

Total amplitude = 2 divisions × 1V/div = 2V

TA = 2V

c) horizontal division = 4 divisions

Time per = 2 ns/div

$$T = 4 \text{ div} \cdot 2 \text{ ns/div} = 8 \text{ ns}$$

$$\text{Frequency} = \frac{1}{T}$$

$$F = \frac{1}{8 \text{ ns}} = \frac{1}{8 \cdot 10^{-9}} = 125 \text{ Hz}$$

No 4

a) i)  $\begin{array}{r} 11011 \\ \times 110 \\ \hline 10110 \end{array} \rightarrow \text{gray code}$

$$\begin{array}{r} 11011 \\ \times 110 \\ \hline 10110 \end{array}$$

B) ii) gray code to binary

$$\begin{array}{r} 1010 \\ \times 11 \\ \hline 1100 \end{array}$$

c) i)  $\begin{array}{r} 123 \\ \times 456 \\ \hline 10011 \cdot 0010 \end{array}$  even parity

$$\begin{array}{r} 123 \\ \times 456 \\ \hline 10011 \cdot 0010 \end{array} \quad \text{answer: (i)}$$

ii)  $\begin{array}{r} 1234 \\ \times 56 - \text{even} \\ \hline 1111011 \cdot 0 \end{array} X$

answer: (ii)

iii)  $\begin{array}{r} 12 \\ \times 3 \\ \hline 0011 \cdot 0001 \end{array}$  odd

No 5

$$9) \quad + 46 \begin{array}{|c} \hline 2 \\ \hline 23 \\ \hline 71 \\ \hline 5 \\ \hline 2 \\ \hline 1 \\ \hline 0 \end{array} \quad \left. \begin{array}{l} 2,0 \\ 2,1 \\ 2,1 \\ 2,1 \\ 2,1 \\ 2,0 \\ 2,1 \end{array} \right\}$$

$$\begin{array}{|c} \hline 2 \\ \hline 12 \\ \hline 6 \\ \hline 3 \\ \hline 1 \\ \hline 0 \end{array} \quad \left. \begin{array}{l} 2,1 \\ 2,0 \\ 2,0 \\ 2,1 \\ 2,1 \\ 2,1 \end{array} \right\}$$

101110

11001

$\downarrow$  ↓ ~~1st complement~~ 867 ↓

00101110

00011001

$\downarrow$  1st complement  $\downarrow$

11010001

11100110

$\downarrow$  2<sup>nd</sup> complement  $\downarrow$

$$+ 11010001$$

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$$11010010$$

$$+ 11100110$$

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$$11100111$$

$$+ 11010010$$
$$+ 11100111$$

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$$110111001 \text{ & Answer}$$

B)  $\begin{array}{r} 70001100 \\ + 00111001 \\ \hline 71000101 \end{array}$  ANSWER

C)  $\begin{array}{r} 01100101 \\ - 11101000 \\ \hline 70000011 \end{array}$  ANSWER

D)

$$\begin{array}{r} 01101010 \\ \times 11110001 \\ \hline 1100101 \\ 0000000 \\ 0000000 \\ 0000000 \\ 1100101 \\ 1100101 \\ \hline 101111100010101 \end{array}$$

ANSWER

No 6

i)  $A\bar{B}C + \bar{A}\bar{B}C + \bar{A}\bar{B}\bar{C}$

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

$\begin{matrix} \text{II} \\ \text{I} \end{matrix}$

$$\bar{B}C(1 + \bar{A}\bar{B}C)$$

$$\bar{B}C + \bar{A}\bar{B}C \Rightarrow C(\bar{A}B + \bar{B}) \Rightarrow C(\bar{A} + \bar{B})$$

$\begin{matrix} \text{II} \\ \text{I} \end{matrix}$

Answer:  $C\bar{A} + C\bar{B}$

ii)  $A\bar{B} + A\bar{B}C + A\bar{B}CD + A\bar{B}CDE$

~~$A\bar{B}$~~   $\bar{A}B$  absorption law:  $A + AB = A$

$$A\bar{B} + A\bar{B}CD + A\bar{B}CDE$$

$$A\bar{B} + A\bar{B}CDE$$

$$A\bar{B}$$

$$(iii) \overline{B}\overline{C}D + \overline{(B+C+D)} + \overline{B}\overline{C}\overline{D}E$$

DeMorgan theorem

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

Hilbert's law.  $A+A\bar{B}=A$

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

$$\overline{B}\overline{C}(D+\overline{D})$$

$\downarrow$   
complement law

$$\overline{\overline{B}\overline{C}} = \overline{B}\overline{C}$$

No 7.

$$i) A\overline{B}CD + AB\overline{C}\overline{D} + \overline{A}\overline{B}CD + \overline{A}\overline{B}\overline{C}\overline{D}$$

A	B	C	D	output
0	0	0	0	1
0	0	0	1	0
0	0	1	0	0
0	0	1	1	1
0	1	0	0	0
0	1	1	0	0
0	1	1	1	0

A	B	C	D	
1	0	0	0	0
1	0	0	1	0
1	0	1	0	1
1	0	1	1	0
1	1	0	0	1
1	1	1	0	0
1	1	1	1	0

W07

ii)  $\bar{X} + \bar{Y}\bar{Z} + WZ + X\bar{Y}\bar{Z}$

W	X	Y	Z	out
0	0	0	0	1
0	0	0	1	1
0	0	1	0	1
0	0	1	1	1
0	1	0	0	0
0	1	0	1	1
0	1	1	0	1
0	1	1	1	0

W	X	Y	Z	out
1	0	0	0	1
1	0	0	1	1
1	0	1	0	1
1	0	1	1	1
1	1	0	0	0
1	1	0	1	1
1	1	1	0	1
1	1	1	1	1

W08

i)  $\bar{D}\bar{E}\bar{F} + \bar{D}\bar{E}\bar{F} + \bar{D}\bar{E}\bar{F} + D\bar{E}\bar{F}$

D	E	F	out
0	0	1	0
0	1	0	0
1	1	0	0
1	0	0	0

$$\bar{D}\bar{F} + E\bar{F}$$

$$ii) \bar{A}\bar{B}\bar{C} + A\bar{B}\bar{C} + \bar{A}B\bar{C} + A\bar{B}\bar{C}$$

$\bar{A}$	$\bar{B}$	$C$	$P$
0	0	0 1	1
0	1	1 0	0
1	0	1 0	0
1	1	0	0

$$\bar{A}\bar{B}\bar{C} + \bar{A}\bar{B}\bar{C}$$

$$iii) (x + \bar{y})(w + \bar{z})(\bar{x} + \bar{y} + \bar{z})(w + x + y + z)$$

$\checkmark$

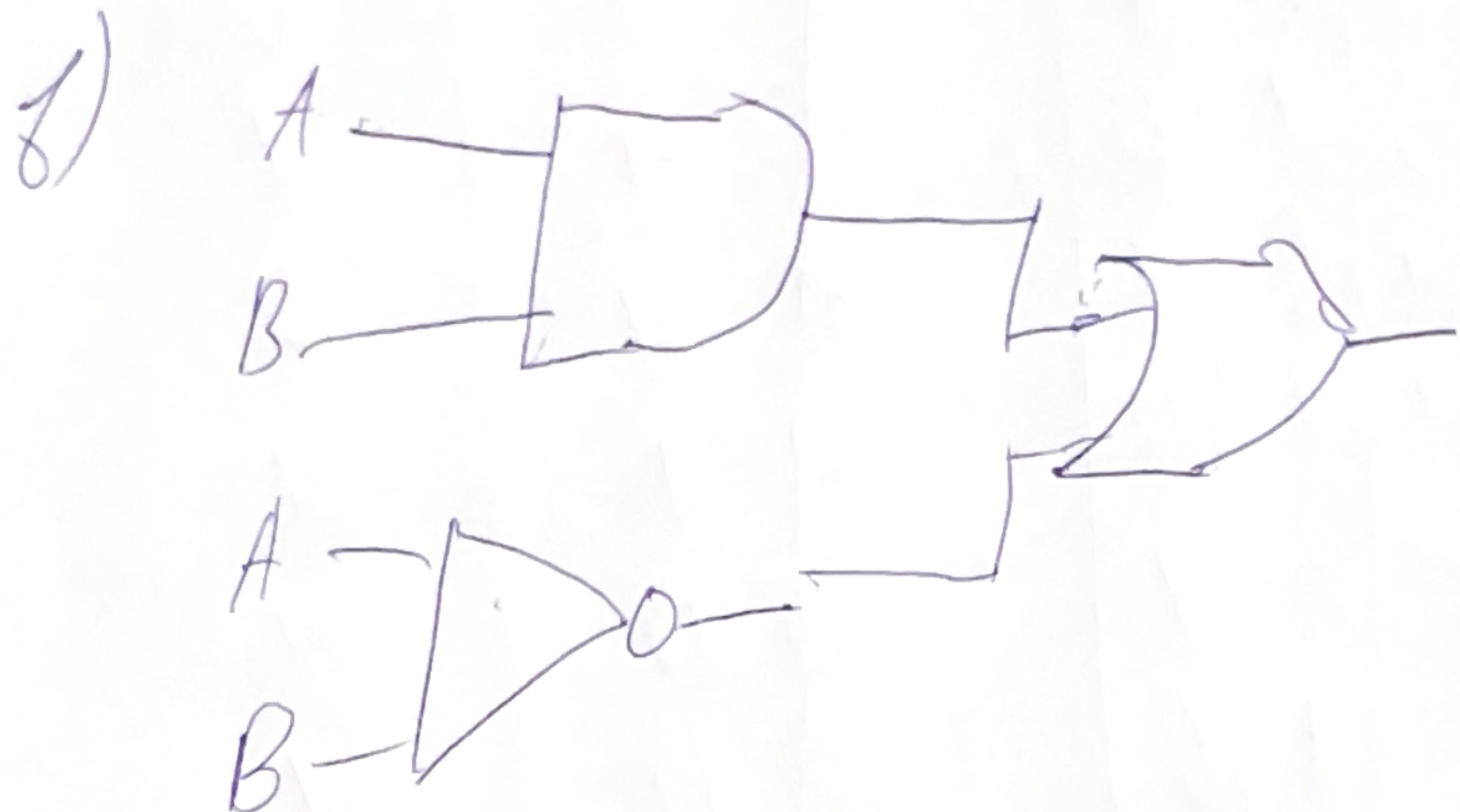
$$\begin{aligned} & \bar{w}x\bar{y}\bar{z} + \bar{w}x\bar{y}\bar{z} + w\bar{x}\bar{y}\bar{z} + \\ & w\bar{x}\bar{y}z + w\bar{x}\bar{y}\bar{z} + w\bar{x}\bar{y}z + \\ & wx\bar{y}\bar{z} \end{aligned}$$

$w$	$x$	$y$	$z$	0 0	0 1	1 1	1 0
0	0	0 1	1	0 0	0 1	1 1	1 0
0	1	1	0	0 1	1 1	1 1	1 1
1	1	0	1	1 1	1 1	1 1	1 1
1	0	1	0	1 0	1 1	1 1	1 0

$$\cancel{x\bar{y}z} \quad x\bar{z} + \bar{w}\bar{y}$$

Wog

$$9) X = \overline{A} \cdot B$$



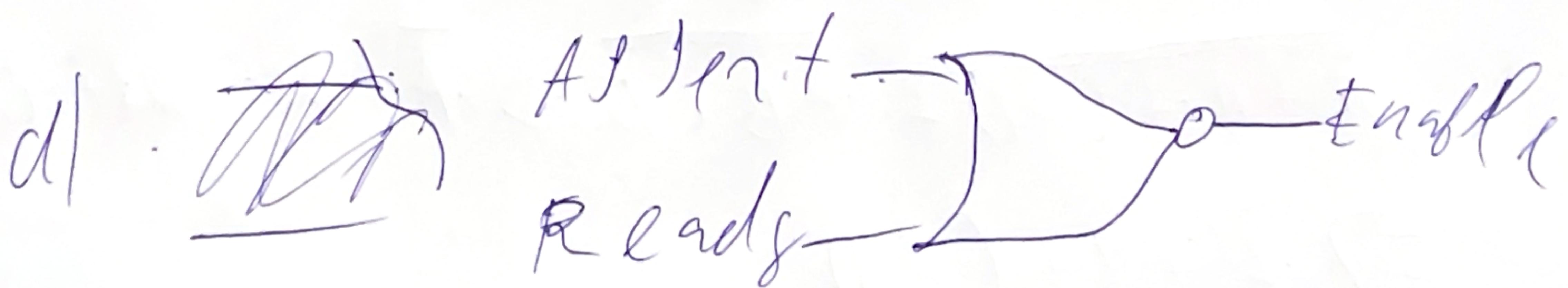
a)

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

$$(A+C\bar{B}+DA+\bar{D}\bar{B}) \Rightarrow$$

$$(A+C\bar{B}+DA) \Rightarrow \cancel{(A+C\bar{B}+DA)}$$

$\wedge$   
Anthen  $\wedge$



	$A$	$\bar{A}$	$B$	$\bar{B}$	$C$	$\bar{C}$	$\bar{A} \text{ or } \bar{B}$	Record
0	1	0	1	0	1	1	0	0
0	1	0	1	1	0	1	1	1
0	1	1	0	0	1	1	1	0
0	1	1	0	1	0	1	1	1
1	0	0	1	0	1	1	1	0
1	0	0	1	1	0	1	1	1
1	0	1	0	0	1	0	0	1
1	0	1	0	1	0	0	0	1

W0.10

$$i) (\underline{A + \bar{D}})(\bar{C} + D) \Rightarrow A + \bar{B} + (\bar{C} + D = 1)$$

$$\underline{A}\bar{B} + \bar{C} + D \Rightarrow \bar{A}\bar{B} + \bar{C} + \bar{B} = AB + \bar{C}\bar{D} \Rightarrow AB + \bar{C}\bar{D}$$

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

$$ii) (\bar{A} + B + (\bar{C} + D))(\bar{A}\bar{B}\bar{C}D) \Rightarrow$$

$$\bar{\bar{A}} + B + \bar{C} + D + \bar{A}\bar{B}\bar{C}D \Rightarrow \bar{A} + B + C + D + A\bar{B}\bar{C}D$$

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