Phan Ngọc Hạnh Nhi
MSSV: 2131209002

Assignment 1

a. Construct the truth table for the two-bit-comparator

A1	A0	B1	B0	A_greater_than_B	
0	0	0	0	0	
0	0	0	1	0	
0	0	1	0	0	
0	0	1	1	0	
0	1	0	0	1	A > B (A = 1, B = 0)
0	1	0	1	0	
0	1	1	0	0	
0	1	1	1	0	
1	0	0	0	1	A > B (A = 2, B = 0)
1	0	0	1	1	A > B (A = 2, B = 1)
1	0	1	0	0	
1	0	1	1	0	
1	1	0	0	1	A > B (A = 3, B = 0)
1	1	0	1	1	A > B (A = 3, B = 1)
1	1	1	0	1	A > B (A = 3, B = 2)
1	1	1	1	0	

b. Write the sum of product form of the function from the truth table.

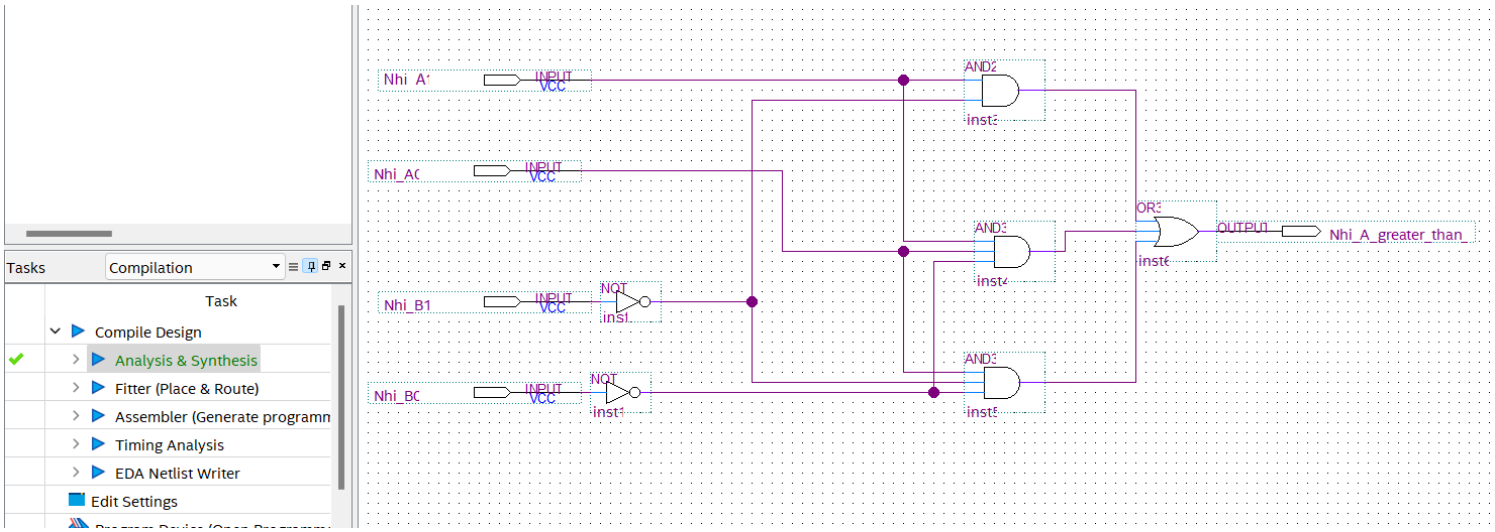
A_greater_than_B = A1’A0B1’B0’ + A1A0’B1’B0’ + A1A0’B1’B0 + A1A0B1’B0’ + A1A0B1’B0 + A1A0B1B0’.

c. **Simplify the function as much as possible:**

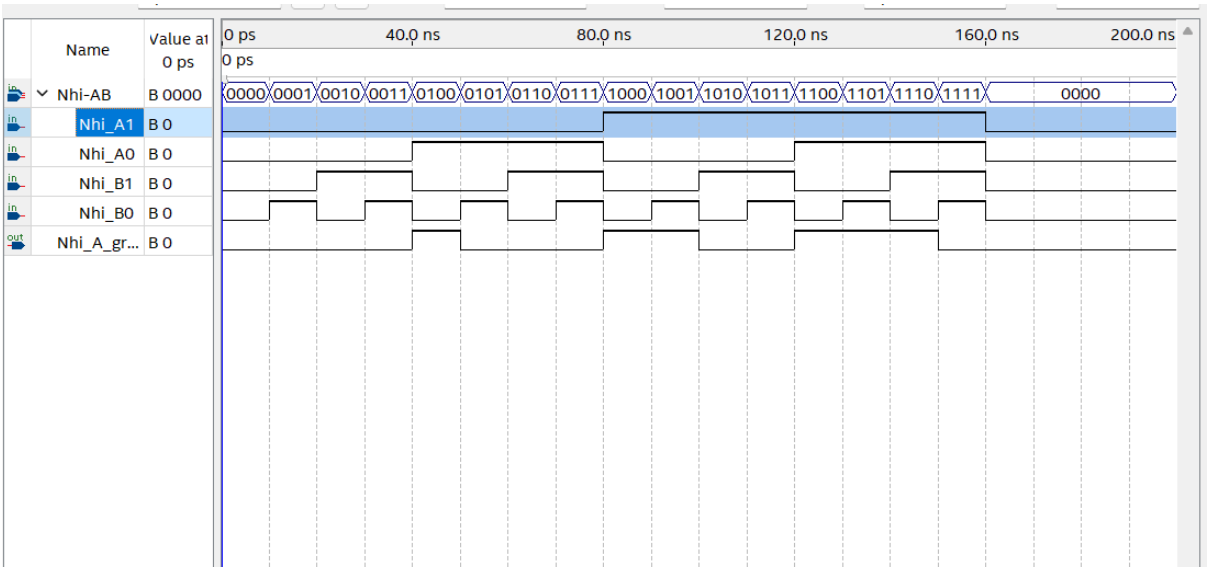
		B1B0			
		00	01	11	10
A1A0	00				
	01	1			
	11	1	1		1
	10	1	1		

A_greater_than_B = A0B1'B0' + A1A0B0' + A1B1'

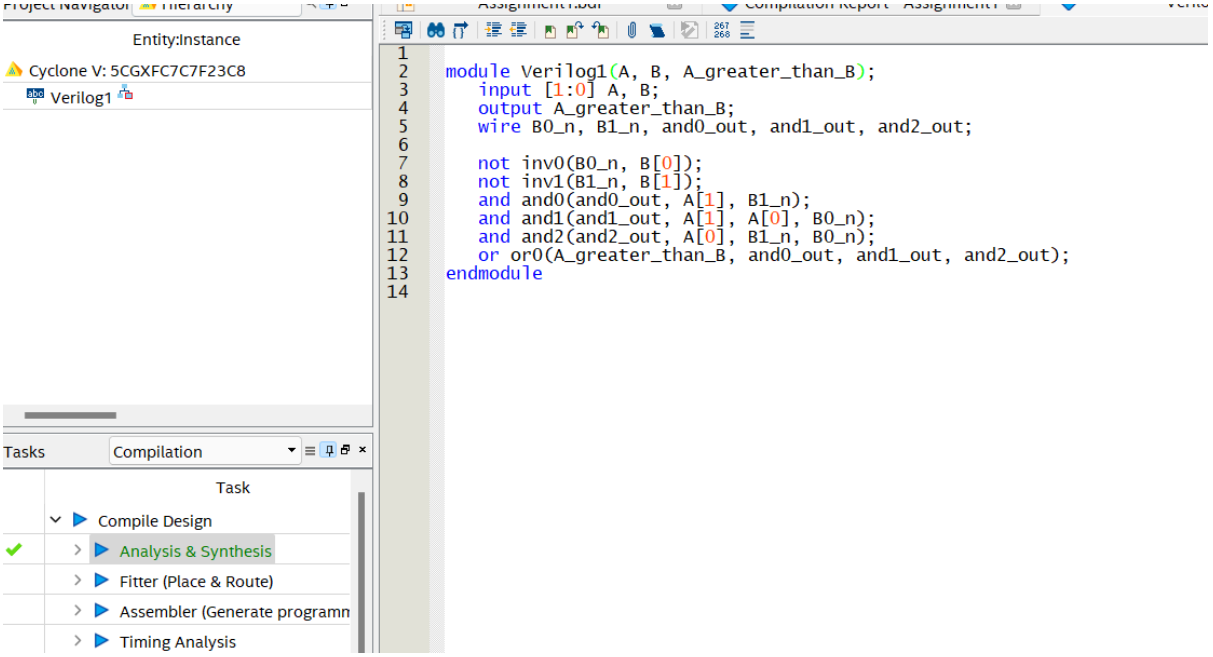
d. Design a logic diagram for the simplified function:



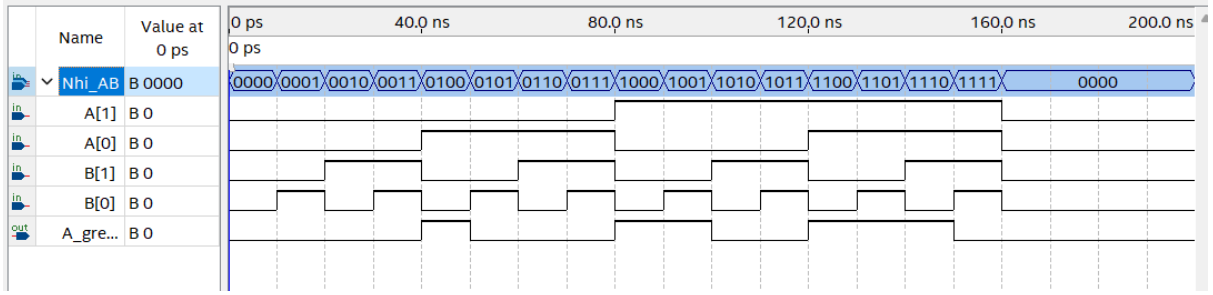
e. Run the simulation of the logic diagram using Simulation Waveform Editor tool:



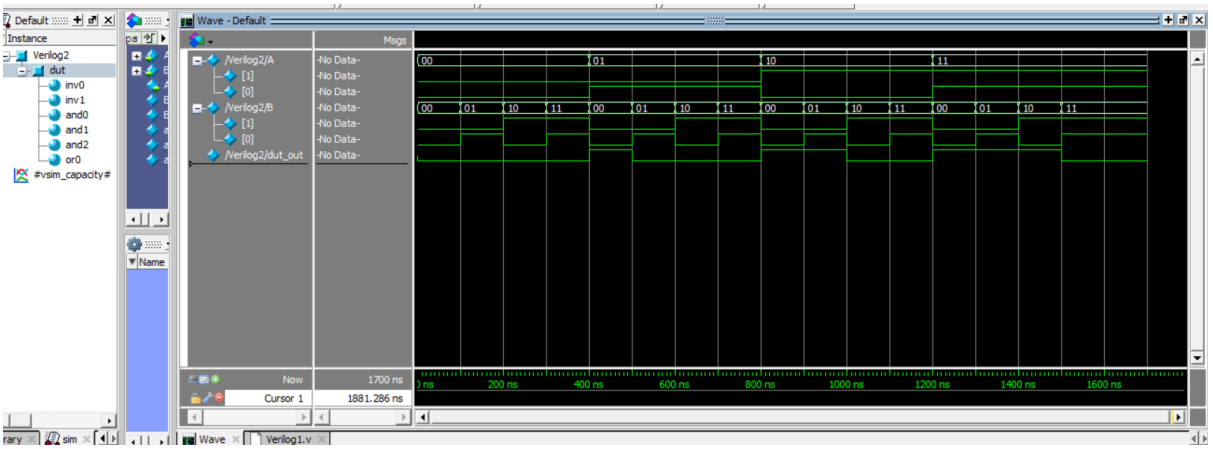
f. Write the Verilog structural description (gate - entry modelling) for the simplified function



g. Run the simulation of the Verilog code using Simulation Waveform Editor tool:



h. Write a Verilog testbench for the Verilog code to test the model:



Assignment 2

a) AB (C + D) + AB (C + D)'

1. **Simplify boolean expression**
   AB (C + D) + AB (C + D)'
   = AB [(C + D) + (C + D)']
   = AB.1
   = AB
2. **Boolean/ Logic Expression:**

$$Z = A \cdot B$$

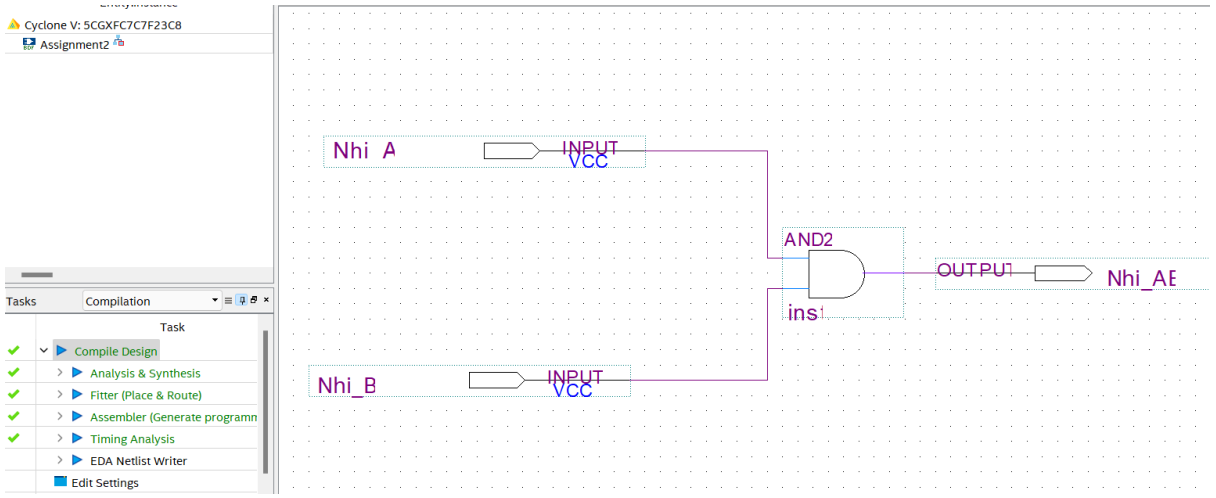
3. **Construct the truth table:**

A	B	AB
0	0	0
0	1	0
1	0	0
1	1	1

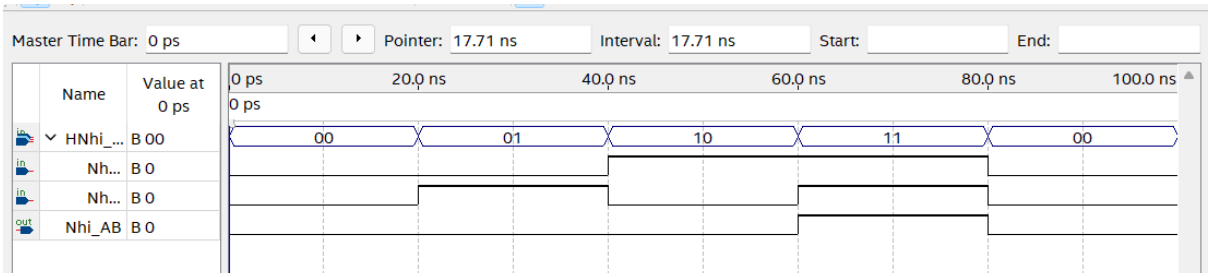
4. **Write the sum of product form of the function from the truth table:**

$$Z = AB$$

5. **Design a logic diagram for the simplified function**



6. **Run the simulation of the logic diagram using Simulation Waveform Editor tool:**

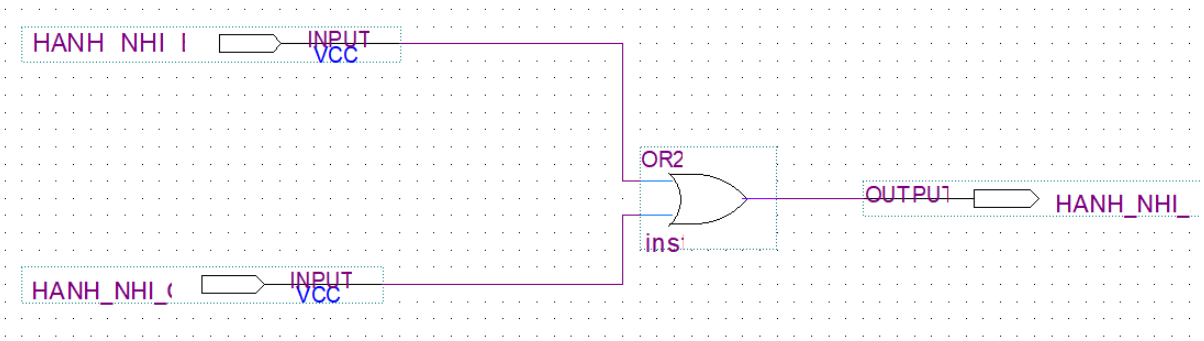


b) AB'C + B + BD' + ABD' + A'C

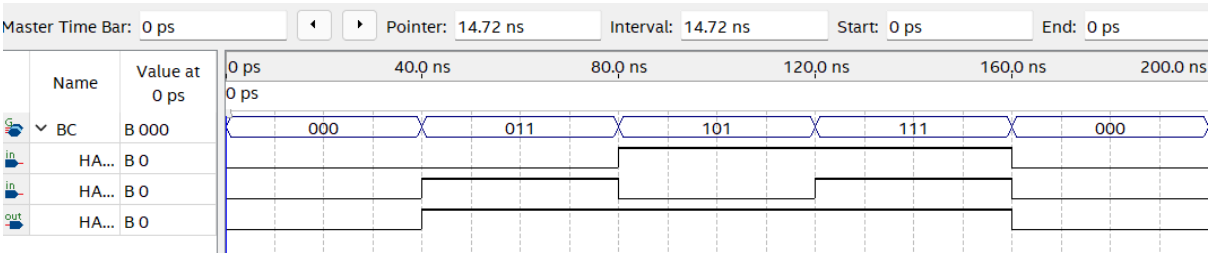
1. **Simplify boolean expression**
   AB (C + D) + AB (C + D)'
   = B(1+D'+AD')+AB'C+A'C
   = B(1+D'(1+A))+AB'C+A'C
   = AB'C+A'C+B
   = AB'C+A'C(B+B')+B
   = AB'C+A'B'C+A'BC+B
   = B'C(A+A')+B(A'C+1)
   = B'C+B
   = B'C+B(1+C)
   = B'C+B+BC
   = C(B'+B)+B
   = B+C
2. **Boolean/ Logic Expression:**
   Z = B + C
3. **Construct the truth table:**

A	B	Z = B or C
0	0	0
0	1	1
1	0	1
1	1	1

4. **Write the sum of product form of the function from the truth table:**
   Z = B + C
5. **Design a logic diagram for the simplified function**

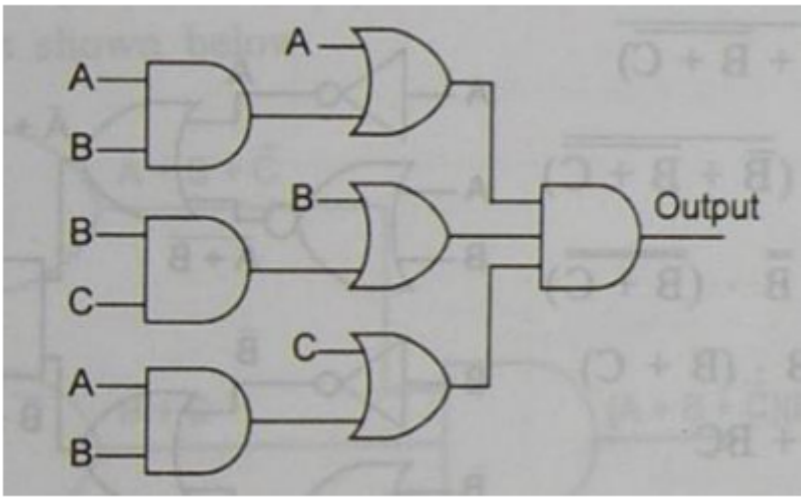


6. **Run the simulation of the logic diagram using Simulation Waveform Editor tool:**



Assignment 3

a)



1. **Write the Boolean expressions:**

$$(A + AB)\ (B + BC)\ (C + AB)$$

2. **Simplify boolean expression:**

(A + AB) (B + BC) (C + AB)

= (A + (1 + B)) (B(1 + C)) (C + AB)

= A.1.B.1.(C + AB)

= AB(C + AB)

= ABC + AB.AB

= ABC + AB

= AB(C + 1)

= AB

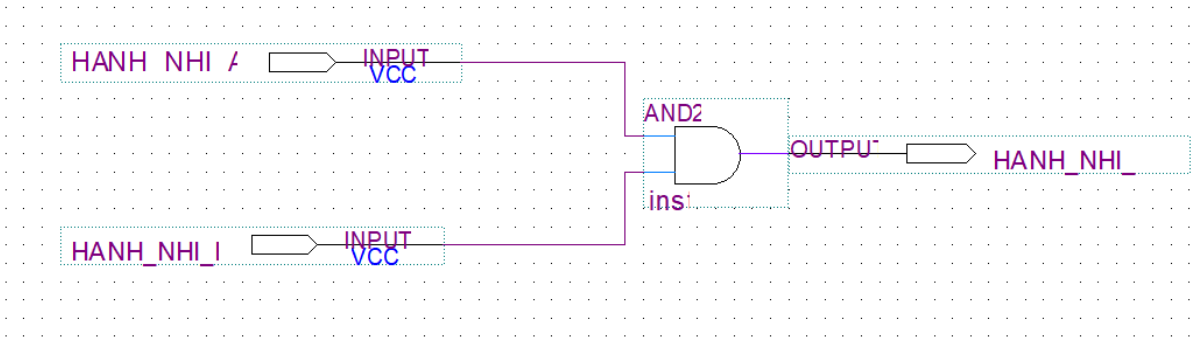
3. **Construct the truth table:**

A	B	Z = A and B
0	0	0
0	1	0
1	0	0
1	1	1

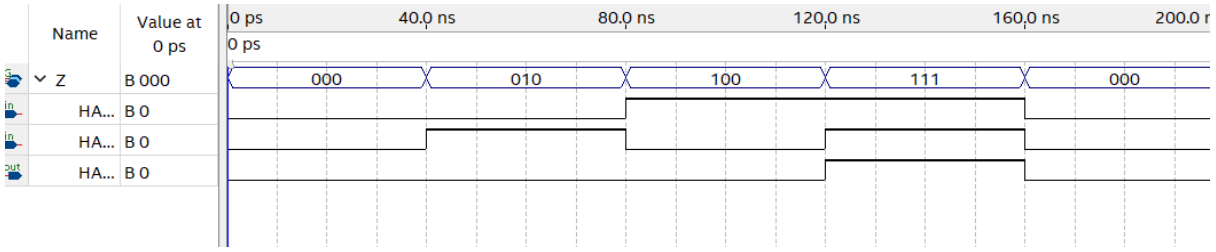
4. **Write the sum of product form of the function from the truth table:**

Z = AB

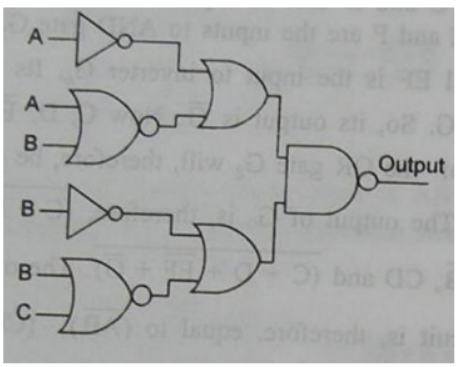
5. **Design a logic diagram for the simplified function:**



6. **Run the simulation of the logic diagram using Simulation Waveform Editor tool:**



b)



1. **Write the Boolean expressions:**

$$((A' + (A + B)) (B' + (B + C)))'$$

2. **Simplify boolean expression:**

((A’ + (A + B)) (B’ + (B + C)))’

= (A’ + (A + B)’) + (B’ + (B + C)’)

= (A” + (A + B)”) + (B” + (B + C)”)

= A + AB + B + BC

= A (1 + B) + B (1 + C)

= A + B

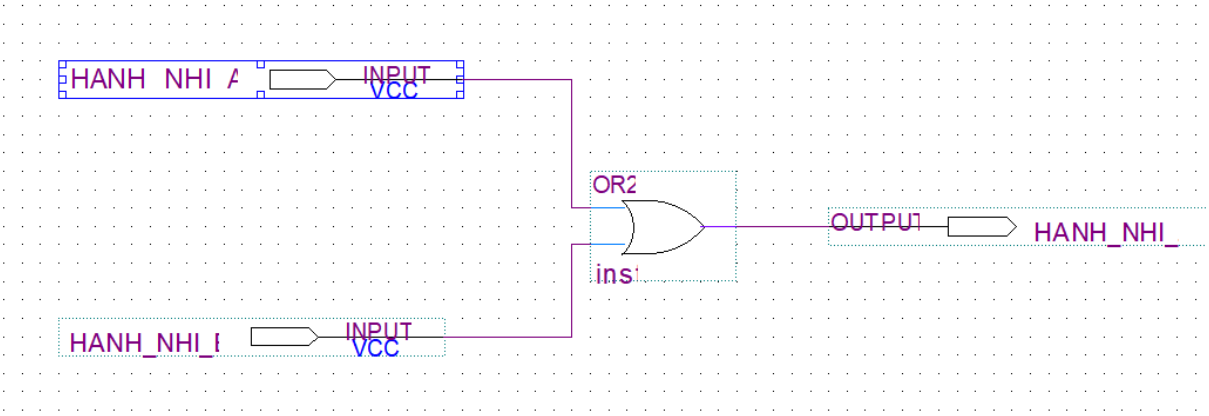
3. **Construct the truth table:**

A	B	Z = A or B
0	0	0
0	1	1
1	0	1
1	1	1

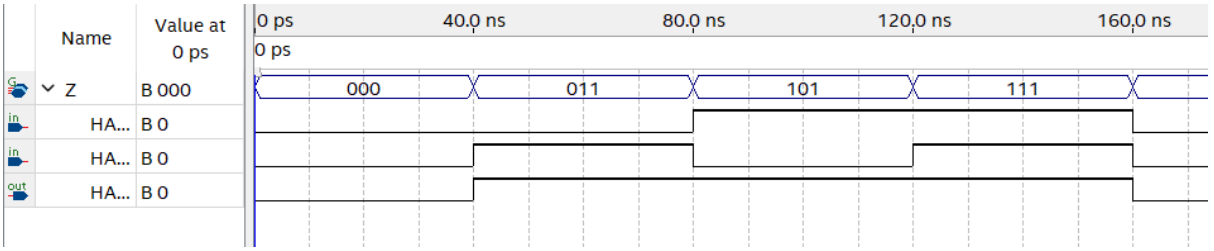
4. **Write the sum of product form of the function from the truth table:**

$$Z = A + B$$

5. **Design a logic diagram for the simplified function:**



6. **Run the simulation of the logic diagram using Simulation Waveform Editor tool:**



Assignment 4

a) Σ m(0, 2, 3, 4, 5, 6)

1. Construct the truth table:

A	B	C	Z
0	0	0	1
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

2. Write the Sum Of Product form:

$$Z_{SOP} = A'B'C' + A'BC' + A'BC + AB'C' + AB'C + ABC'$$

3. Write the Product Of Sum form:

$$Z_{POS} = (A + B + C')\,(A' + B' + C')$$

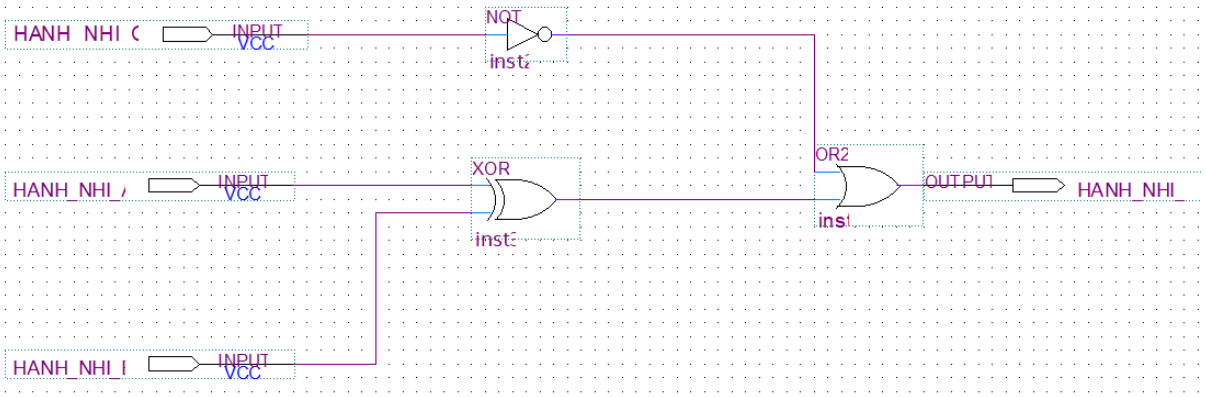
4. Simplify the function as much as possible

		BC			
		00	01	11	10
A	0	1		1	1
	1	1	1		1

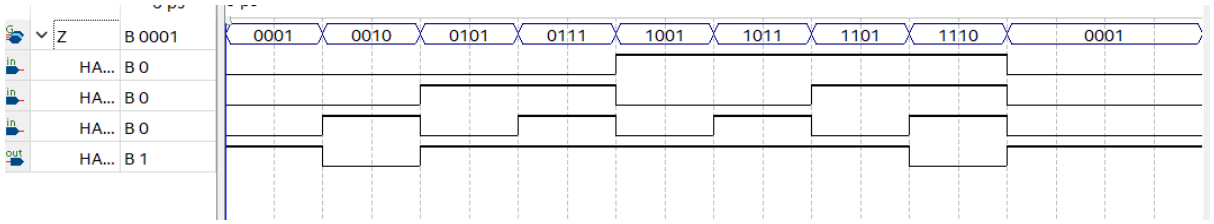
=> Z = C' + A'B + AB'

= C' + (A ⊕ B)

5. Design a logic diagram for the simplified function



6. **Run the simulation of the logic diagram using Simulation Waveform Editor tool**



b) Π M(0, 1, 2, 3 , 4, 7)

1. **Construct the truth table:**

A	B	C	Z
0	0	0	0
0	0	1	0
0	1	0	0
0	1	1	0
1	0	0	0
1	0	1	1
1	1	0	1
1	1	1	0

2. **Write the Sum Of Product form:**

$$Z_{SOP} = AB'C + ABC'$$

3. **Write the Product Of Sum form:**

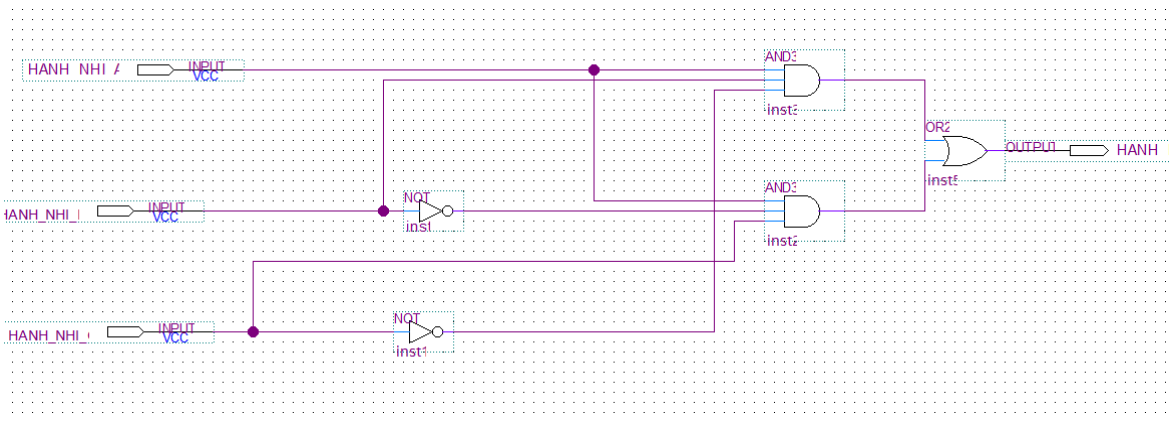
$$Z_{POS} = (A + B + C)\,(A + B + C')\,(A + B' + C)\,(A + B' + C')\,(A' + B + C)\,(A' + B' + C')$$

4. **Simplify the function as much as possible**

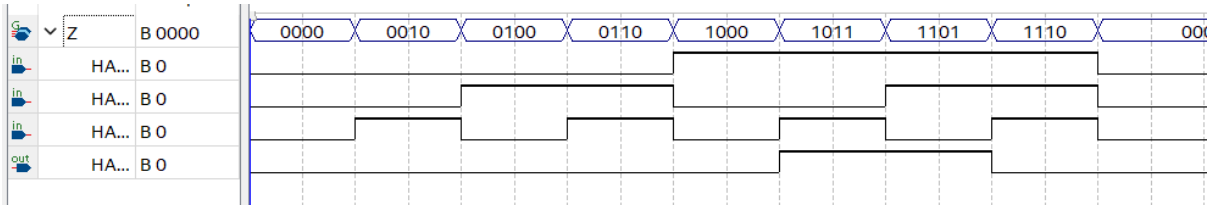
		BC			
		00	01	11	10
A	0				
	1		1		1

=> Z = AB'C + ABC'

5. **Design a logic diagram for the simplified function**



6. **Run the simulation of the logic diagram using Simulation Waveform Editor tool**



Assignment 5

a) Σ m (0, 1, 2, 3, 5, 7, 8, 9, 10, 12, 13)

1. **Construct the truth table:**

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

2. **Write the Sum Of Product form:**

Z_{SOP} = A'B'C'D' + A'B'C'D + A'B'CD' + A'B'CD + A'BC'D + A'BCD + AB'C'D' + AB'C'D + AB'CD' + ABC'D' + ABC'D

3. **Write the Product Of Sum form:**

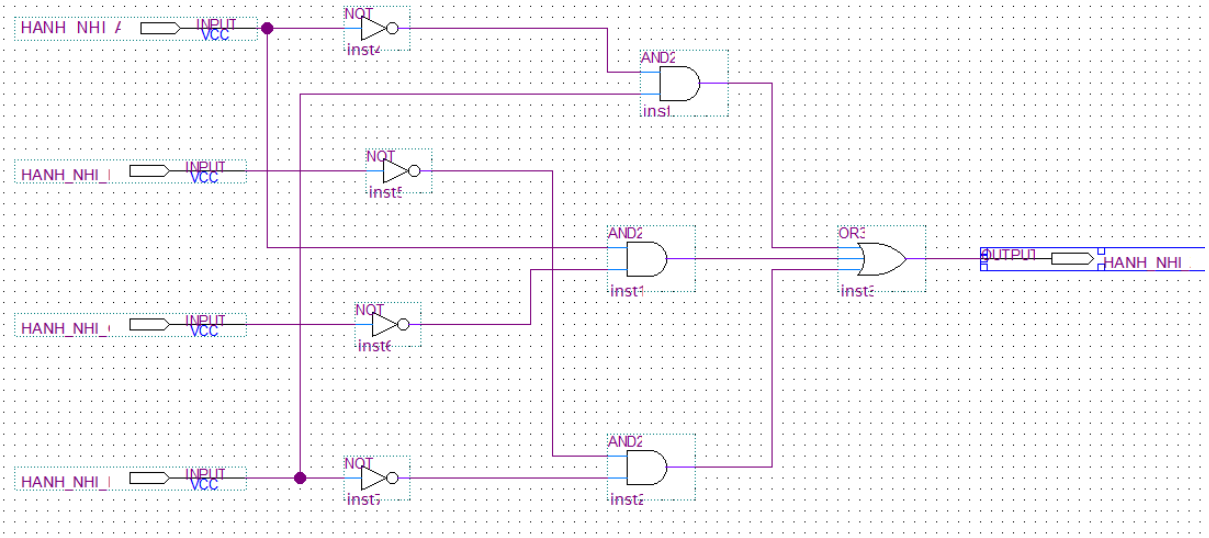
Z_{POS} = (A + B' + C + D) (A + B' + C' + D) (A' + B + C' + D') (A' + B' + C' + D) (A' + B' + C' + D')

4. **Simplify the function as much as possible**

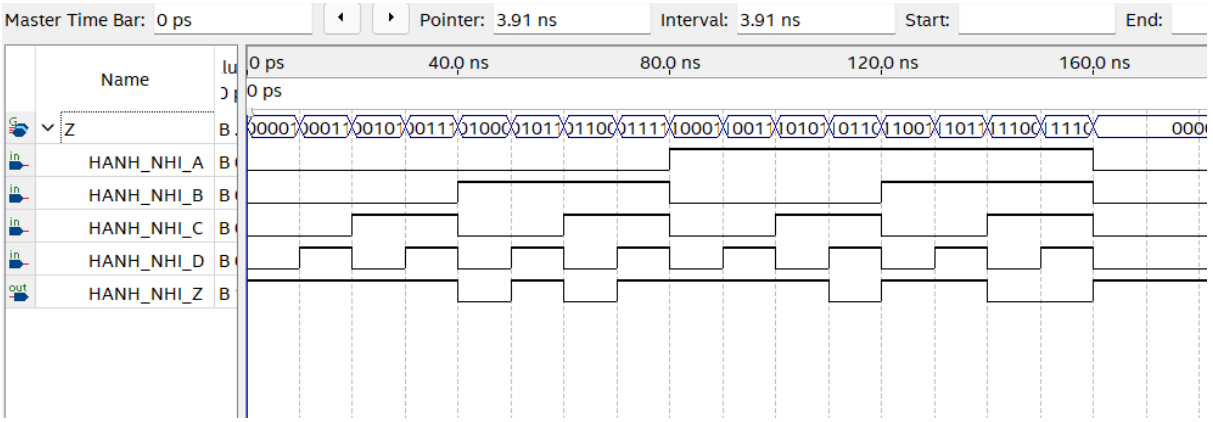
		CD			
		00	01	11	10
AB	00	1	1	1	1
	01		1	1	
	11	1	1		
	10	1	1		1

=> Z = A'D + AC' + B'D'

5. **Design a logic diagram for the simplified function**



6. **Run the simulation of the logic diagram using Simulation Waveform Editor tool**



b) Π M(2, 8, 9, 10, 11, 12, 14)

1. **Construct the truth table:**

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

2. **Write the Sum Of Product form:**

Z_{SOP} = A'B'C'D' + A'B'C'D + A'B'CD + A'BC'D' + A'BC'D + A'BCD' + A'BCD + ABC'D + ABCD

3. **Write the Product Of Sum form:**

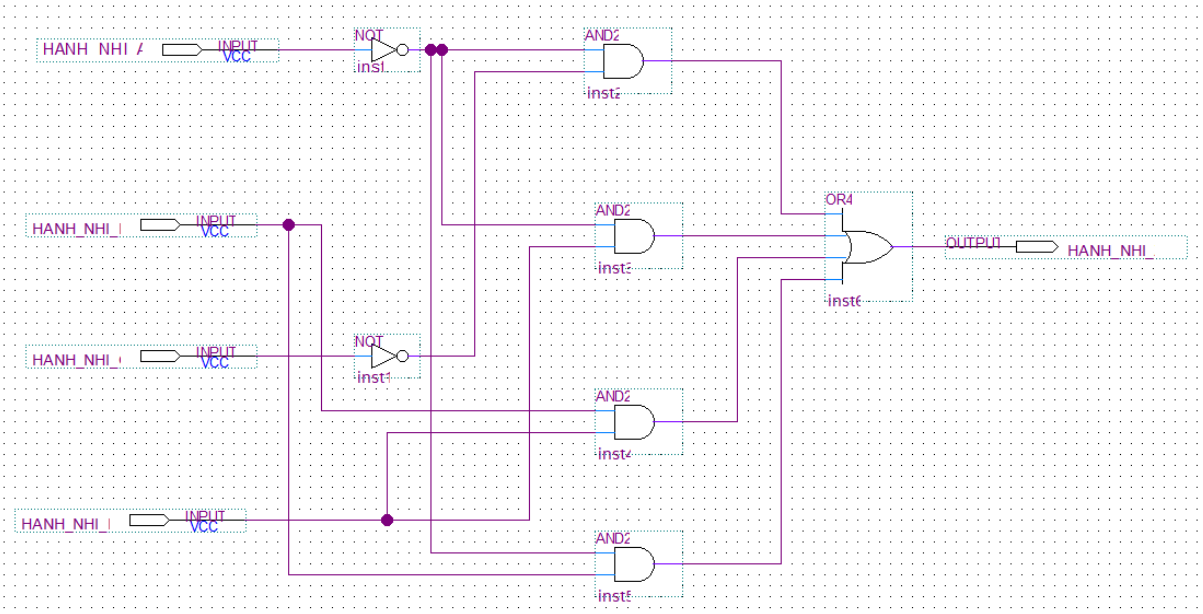
Z_{POS} = (A + B + C' + D) (A' + B +C + D) (A' + B + C + D') (A' + B + C' + D) (A' + B + C' + D') (A' + B' + C + D) (A' + B' + C' + D)

4. **Simplify the function as much as possible**

		CD			
		00	01	11	10
AB	00	1	1	1	
	01	1	1	1	1
	11		1	1	
	10				

=> **Z** = A'C' + A'D + BD + A'B

5. **Design a logic diagram for the simplified function**



6. **Run the simulation of the logic diagram using Simulation Waveform Editor tool**