

Assignment 1

1. Design a logic diagram for a full adder

Z	0	0	0	0
X	0	0	1	1
+Y	+0	+1	+0	+1
C S	00	01	01	10
Z	1	1	1	1
X	0	0	1	1
+Y	+0	+1	+0	+1
C S	01	10	10	11

- Truth table of full adder:

Inputs				Outputs	
X	Y	Z		C	S
0	0	0		0	0
0	0	1		0	1
0	1	0		0	1
0	1	1		1	0
1	0	0		0	1
1	0	1		1	0
1	1	0		1	0
1	1	1		1	1

- K-Map:

S		YZ			
		00	01	11	10
X	0		1		1
	1	1		1	

C		YZ			
		00	01	11	10
X	0			1	
	1		1	1	1

- **Simplify boolean expression:**

$$S = X'Y'Z + X'YZ' + XY'Z' + XYZ$$

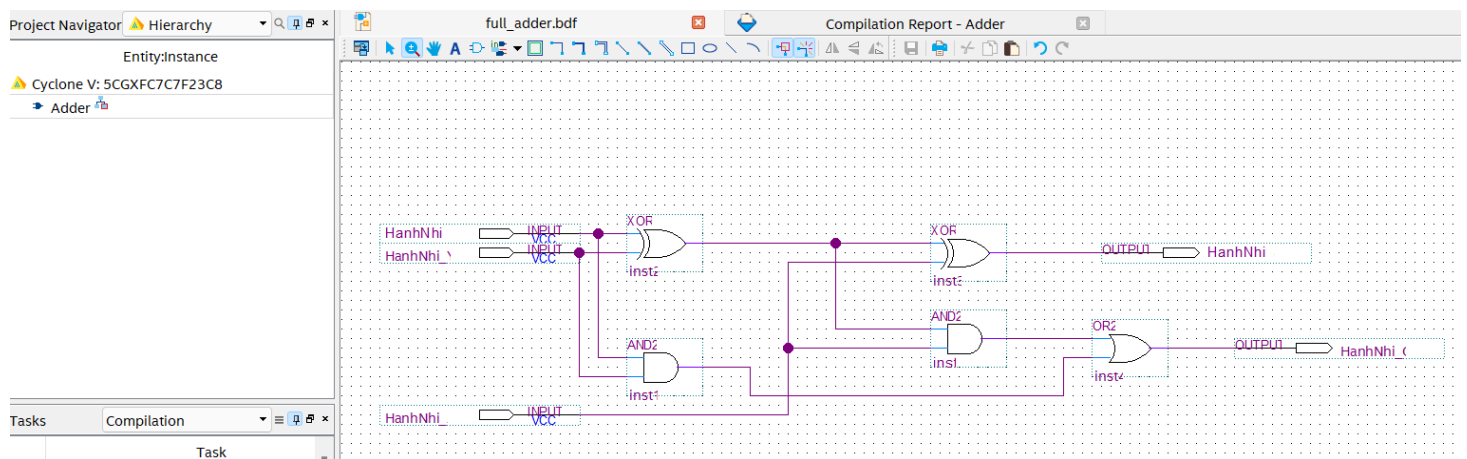
$$= X \oplus Y \oplus Z$$

$$C = XY + XZ + YZ$$

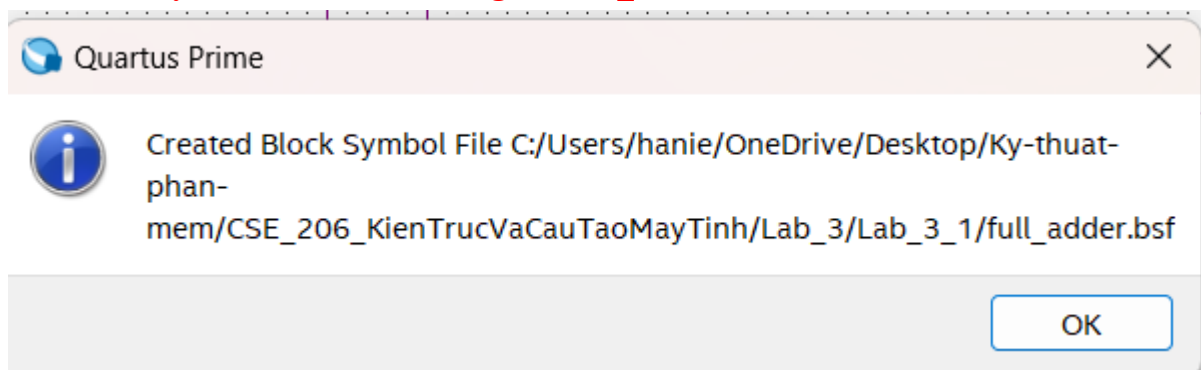
$$= XY + Z(XY' + X'Y)$$

$$= XY + Z(X \oplus Y)$$

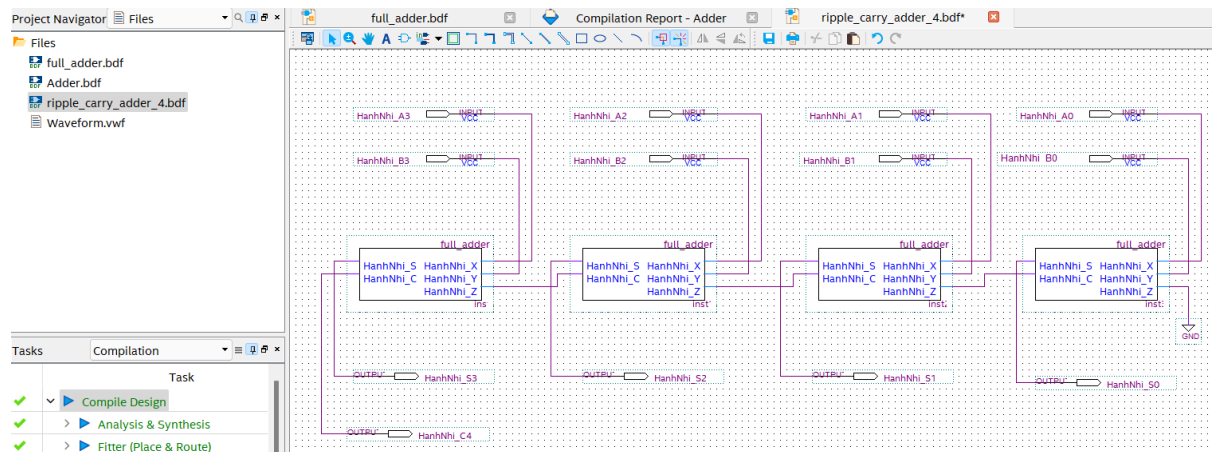
- Create a new project named Adder.
- Add a new block diagram file (schematic file) named full_adder.bdf into the project.



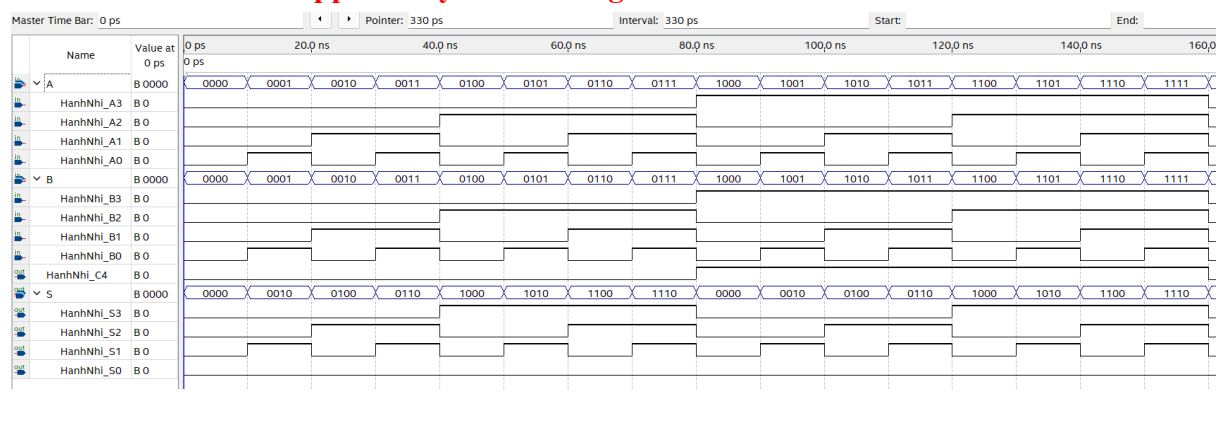
2. Create a symbol for the block diagram full_adder.



3. Design a block diagram of 4-bit ripple carry adder named ripple_carry_adder_4.bdf using the full_adder circuit created in the previous step.

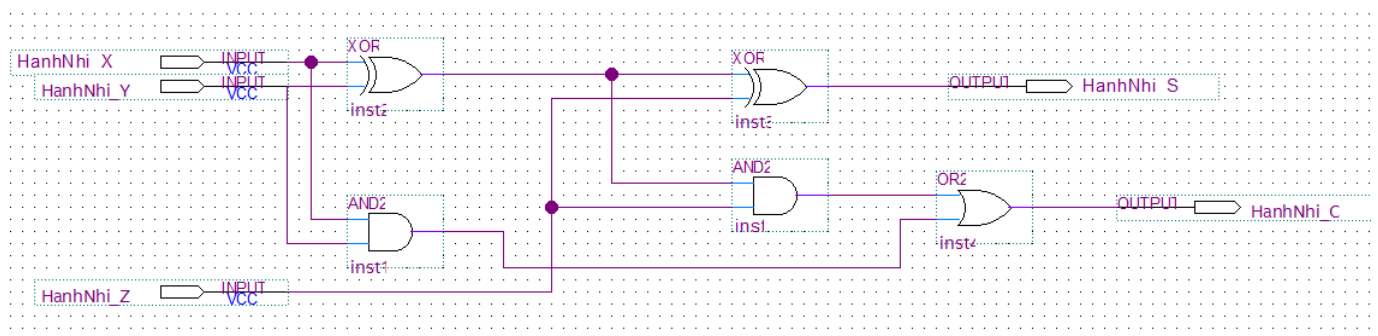


4. Simulate the 4-bit ripple carry adder using waveform editor tool



Assignment 2

a) Design a logic diagram for a full adder.



b) Design a block diagram of 4-bit adder-subtractor.

Assignment 3

a) Truth table:

Decimal	Gray Code (Input)				BCD (Output)			
	A	B	C	D	X	Y	Z	W
0	0	0	0	0	0	0	0	0
1	0	0	0	1	0	0	0	1
3	0	0	1	0	0	0	1	1
2	0	0	1	1	0	0	1	0
7	0	1	0	0	0	1	1	1
6	0	1	0	1	0	1	1	0
4	0	1	1	0	0	1	0	0
5	0	1	1	1	0	1	0	1
Invalid	1	0	0	0	1	1	1	1
Invalid	1	0	0	1	1	1	1	1
Invalid	1	0	1	0	1	1	1	1
Invalid	1	0	1	1	1	1	1	1
8	1	1	0	0	1	0	0	0
9	1	1	0	1	1	0	0	1
Invalid	1	1	1	0	1	1	1	1
Invalid	1	1	1	1	1	1	1	1

b) Simplify the function as much as possible:

• X:

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

$$\Rightarrow X = A$$

- Y:

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

$$\Rightarrow Y = A'B + AC + AB'$$

$$= (A \oplus B) + AC$$

- Z:

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

$$\Rightarrow Z = B'C + A'BC' + AC + AB'$$

$$= B'(C + A) + A'BC' + AC$$

- W:

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

$$\Rightarrow W = B'C'D + B'CD' + A'BC'D' + BCD + AC + AB' + AD$$

$$= D(B'C' + BC + A) + D'(B'C + A'BC') + A(C + B')$$

c) Design a logic diagram for the simplified function:

1	0	0	1	0	0	1	1	0	0
1	0	1	0	0	0	1	1	0	0
1	0	1	1	0	0	1	1	0	0
1	1	0	0	0	0	1	1	0	0
1	1	0	1	0	0	1	1	0	0
1	1	1	0	0	0	1	1	0	0
1	1	1	1	0	1	0	1	0	0

b) Simplify the function as much as possible:

- RNS:

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

$$\Rightarrow \text{RNS} = A' + B'C'D'$$

- YNS:

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

$$\Rightarrow \text{YNS} = ABCD$$

- GNS:

GNS		CD			
		00	01	11	10
AB	00				
	01				

GNS		CD			
		00	01	11	10
	11	1	1		1
	10		1	1	1

$$\Rightarrow \text{GNS} = \text{ABD}' + \text{AC}'\text{D} + \text{AB}'\text{C}$$

- REW:

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

$$\Rightarrow \text{REW} = \text{A} + \text{B}'\text{C}'\text{D}'$$

- YEW:

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

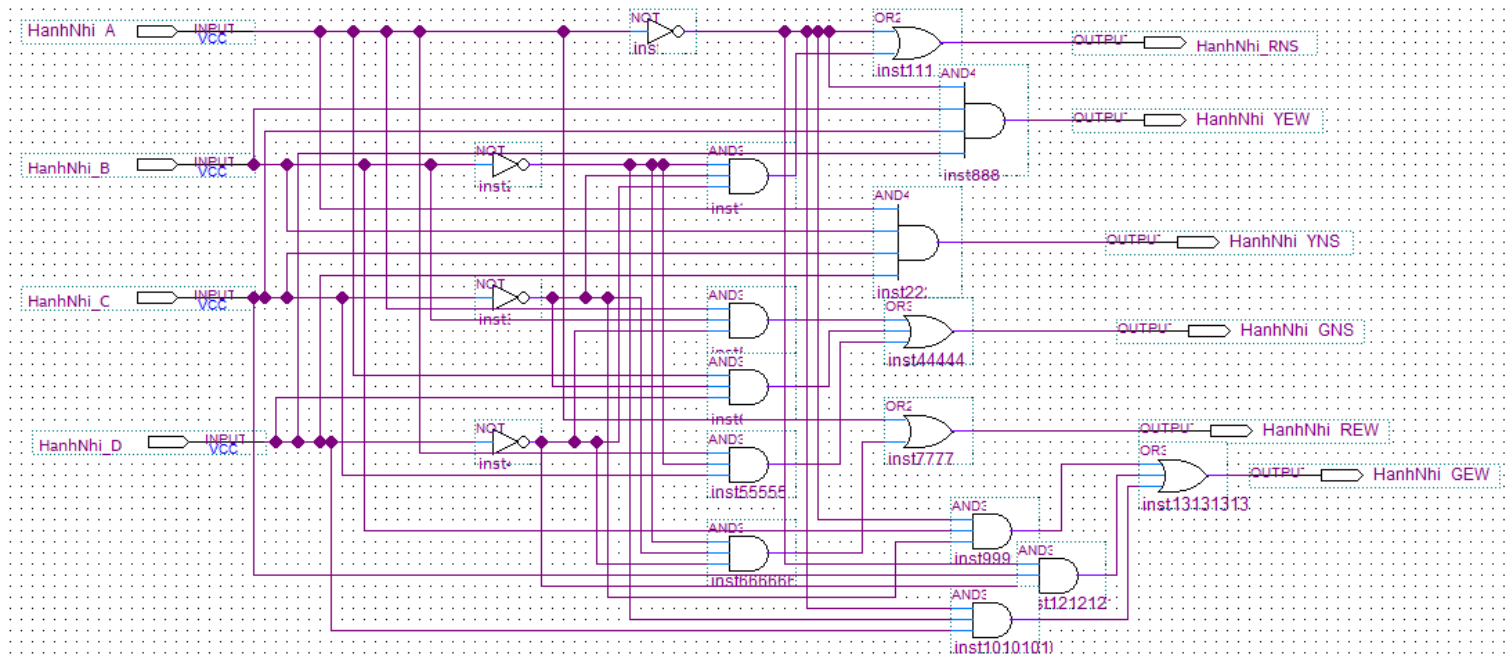
$$\Rightarrow \text{YEW} = \text{A}'\text{BCD}$$

- GEW:

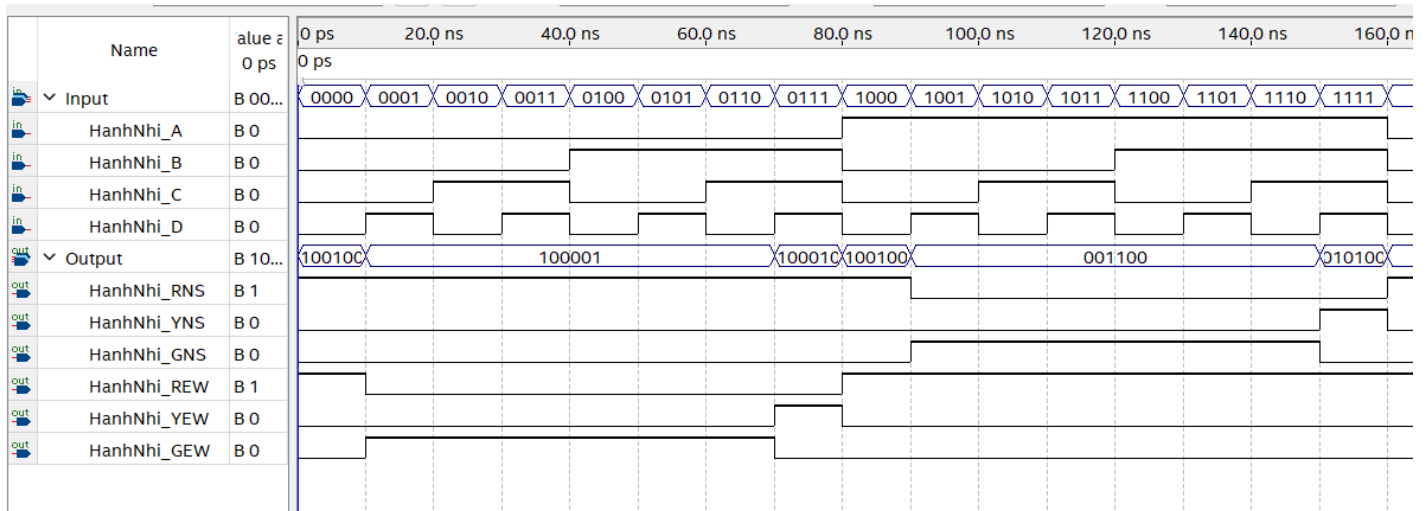
GEW		CD			
		00	01	11	10
AB	00		1	1	1
	01	1	1		1
	11				
	10				

$$\Rightarrow \text{GEW} = A'BC' + A'B'D + A'CD'$$

c) Design a logic diagram for the simplified function:



d) Run the simulation of the logic diagram using Simulation Waveform Editor tool:



Assignment 5

a) Truth table:

Inputs			Outputs					
A	B	C	Y5	Y4	Y3	Y2	Y1	Y0
0	0	0	0	0	0	0	0	0
0	0	1	0	0	0	0	0	1
0	1	0	0	0	0	1	0	0
0	1	1	0	0	1	0	0	1
1	0	0	0	1	0	0	0	0
1	0	1	0	1	1	0	0	1
1	1	0	1	0	0	1	0	0
1	1	1	1	1	0	0	0	1

b) Simplify the function as much as possible:

- Output Y0:
 - $Y0 = 1$ for 001, 011, 101, 111
 - $Y0 = A'B'C + A'BC + AB'C + ABC$

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

$$= C [A'(B' + B) + A(B' + B)]$$

$$= C (A' \cdot 1 + A \cdot 1)$$

$$= C$$
- Output Y1:
 - $Y1 = 0$
 - $Y1 = \text{GND}$
- Output Y2:
 - $Y2 = 1$ for 010, 110
 - $Y2 = A'BC' + ABC'$

$$= BC' (A' + A)$$

$$= BC'$$
- Output Y3:
 - $Y3 = 1$ for 011, 101
 - $Y3 = A'BC + AB'C$

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

$$= C (A \oplus B)$$

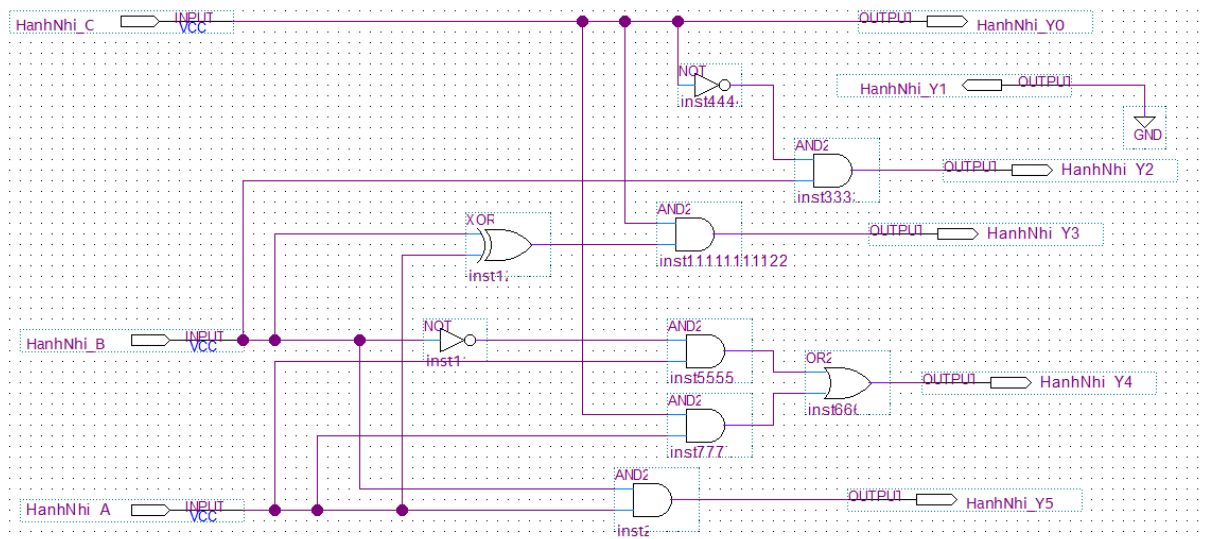
- Output Y4:
 - $Y4 = 1$ for 100, 101, 111
 - $Y4 = AB'C' + AB'C + ABC$

		BC			
		00	01	11	10
A	0				
	1	1	1	1	

$\Rightarrow AB' + AC$

- Output Y5:
 - $Y5 = 1$ for 110, 111
 - $Y5 = ABC' + ABC$
 $= AB(C' + C)$
 $= AB$

c) Design a logic diagram for the simplified function:



d) Run the simulation of the logic diagram using Simulation Waveform Editor tool:

