

HO CHI MINH CITY UNIVERSITY OF TECHNOLOGY – VNU HCMC  
OFFICE FOR INTERNATIONAL STUDY PROGRAM  
FACULTY OF ELECTRICAL AND ELECTRONIC ENGINEERING

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## DIGITAL SYSTEMS (LAB) EXPERIMENTAL REPORT (Prelab 3)

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# III Pre Laboratory 3

## Adders, subtractors and multipliers

### 1. Known how to program an adder using '+' sign in VHDL

#### a. Code

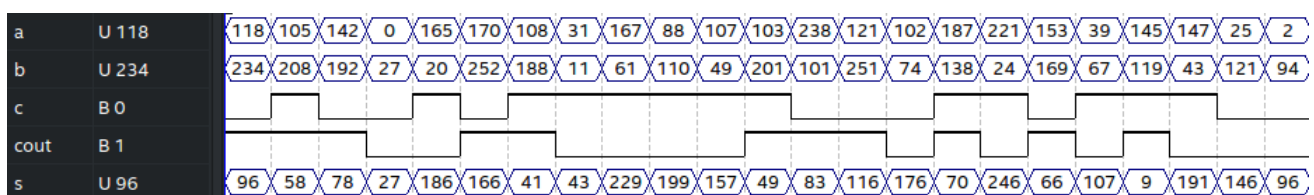
Exc1.vhdl

```
LIBRARY ieee;
USE ieee.std_logic_1164.ALL;
USE ieee.std_logic_arith.ALL;
USE ieee.std_logic_signed.ALL;

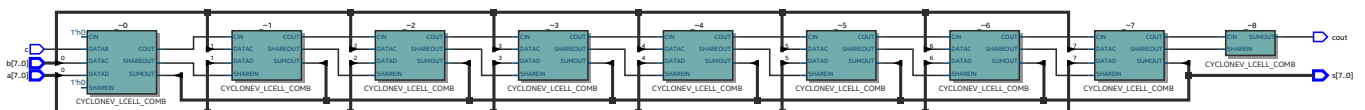
ENTITY Exc1 IS
    PORT (
        a, b : IN STD_LOGIC_VECTOR(7 DOWNTO 0);
        c : IN STD_LOGIC;
        s : OUT STD_LOGIC_VECTOR(7 DOWNTO 0);
        cout : OUT STD_LOGIC
    );
END Exc1;

ARCHITECTURE arch OF Exc1 IS
    SIGNAL sum : STD_LOGIC_VECTOR(8 DOWNTO 0);
BEGIN
    sum <= ('0' & a) + ('0' & b) + ("0000000" & c);
    s <= sum(7 DOWNTO 0);
    cout <= sum(8);
END ARCHITECTURE;
```

#### b. Waveform



#### c. Result of RTL viewer



## 2. Known how to program a multiplier

### a. Code

#### Exc2.vhdl

```

LIBRARY ieee;
USE ieee.std_logic_1164.ALL;
USE ieee.std_logic_unsigned.ALL;
USE IEEE.numeric_std.ALL;

ENTITY Exc2 IS
    PORT (
        a, b : IN STD_LOGIC_VECTOR(7 DOWNTO 0);
        p : OUT STD_LOGIC_VECTOR(15 DOWNTO 0)
    );
END Exc2;

ARCHITECTURE arch OF Exc2 IS
    SIGNAL a_padded, zero : STD_LOGIC_VECTOR(15 DOWNTO 0);
    TYPE ab_t IS ARRAY(0 TO 7) OF STD_LOGIC_VECTOR(15 DOWNTO 0);
    SIGNAL ab : ab_t;

BEGIN

    zero <= "0000000000000000";
    a_padded <= "00000000" & a;

    ab(0) <= a_padded WHEN b(0) = '1' ELSE zero;
    sum : FOR i IN 1 TO 7 GENERATE
        ab(i) <= a_padded(15 - i DOWNTO 0) & zero(i - 1 DOWNTO 0) WHEN b(i) = '1' ELSE zero;
    END GENERATE;

    p <= ab(0) + ab(1) + ab(2) + ab(3) + ab(4) + ab(5) + ab(6) + ab(7);
END ARCHITECTURE;

```

### b. Waveform

a	U 47	47	161	255	118	127	213	178	104	74	11	68	45	117	148	75
b	U 95	95	70	1	206	62	130	144	205	59	103	131	226	18	250	206
p	U 4465	4465	11270	255	24308	7874	27690	25632	21320	4366	1133	8908	10170	2106	37000	15450

### c. Result of RTL viewer

