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 2)

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Contents

II Pre Laboratory 2

Adder and flip-flop

1. Known how to program full adder

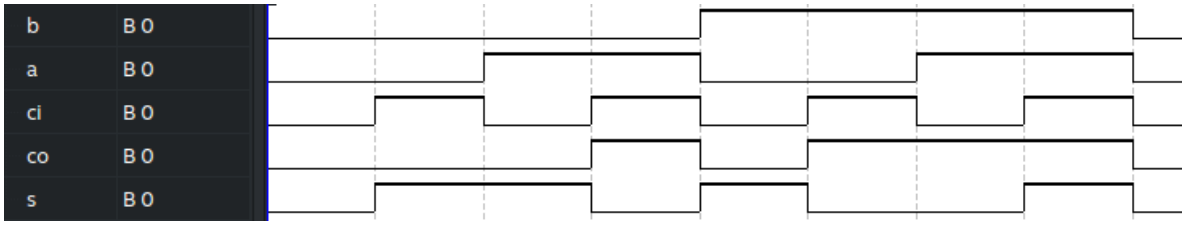
$$s = a \oplus b \oplus c_{in}$$
$$c_{out} = ab \oplus c_{in}(a + b)$$

a. Code

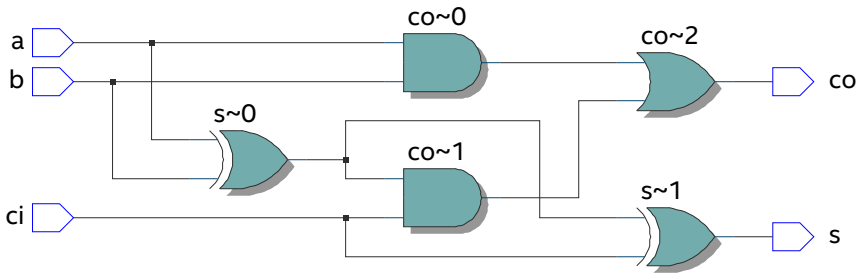
Exc1.vhdl

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

ENTITY Exc1 IS
        PORT (
                a : IN STD_LOGIC;
                b : IN STD_LOGIC;
                ci : IN STD_LOGIC;
                s : OUT STD_LOGIC;
                co : OUT STD_LOGIC
        );
END Exc1;

ARCHITECTURE arch OF Exc1 IS
BEGIN
        s <= a XOR b XOR ci;
        co <= (a AND b) OR (ci AND (a XOR b));
END ARCHITECTURE;
```

b. Waveform



c. Result of RTL viewer



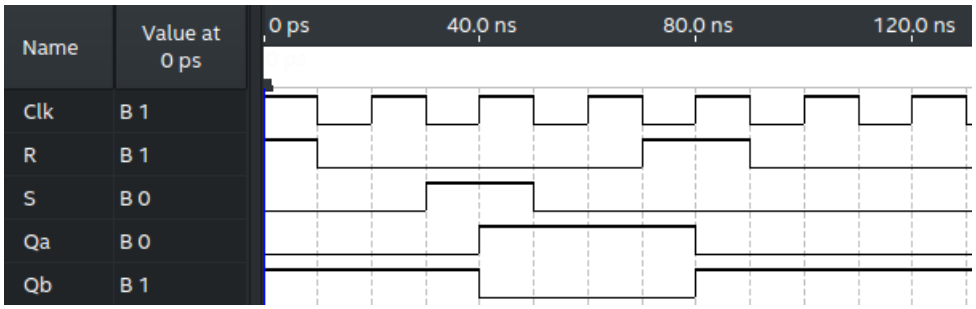
2. Understand RS-latched circuit

a. Code

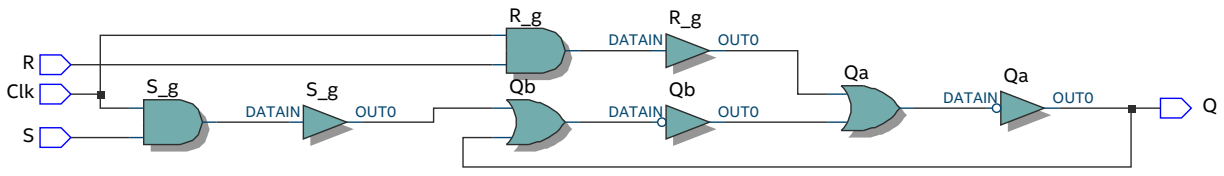
Exc2.vhdl

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

ENTITY Exc2 IS
        PORT (
                Clk, R, S : IN STD_LOGIC;
                Q : OUT STD_LOGIC
        );
END Exc2;

ARCHITECTURE Structural OF Exc2 IS
        SIGNAL R_g, S_g, Qa, Qb : STD_LOGIC;
        ATTRIBUTE KEEP : BOOLEAN;
        ATTRIBUTE KEEP OF R_g, S_g, Qa, Qb : SIGNAL IS TRUE;
BEGIN
        R_g <= R AND Clk;
        S_g <= S AND Clk;
        Qa <= R_g NOR Qb;
        Qb <= S_g NOR Qa;
        Q <= Qa;
END Structural;
END ARCHITECTURE;
```

b. Waveform



c. Result of RTL viewer



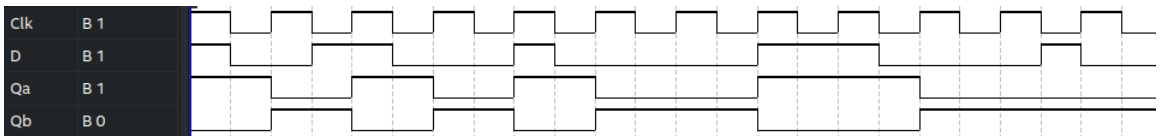
3. Understand D-latched circuit

a. Code

Exc3.vhdl

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

ENTITY Exc3 IS
        PORT (
                Clk, D : IN STD_LOGIC;
                Q : OUT STD_LOGIC
        );
END Exc3;

ARCHITECTURE Structural OF Exc3 IS
        SIGNAL R_g, S_g, Qa, Qb, S, R : STD_LOGIC;
        ATTRIBUTE KEEP : BOOLEAN;
        ATTRIBUTE KEEP OF R_g, S_g, Qa, Qb : SIGNAL IS TRUE;

BEGIN
        S <= D;
        R <= NOT(D);
        R_g <= R AND Clk;
        S_g <= S AND Clk;
        Qa <= R_g NOR Qb;
        Qb <= S_g NOR Qa;
        Q <= Qa;
END Structural;
```

b. Waveform



c. Result of RTL viewer