Batch:	D-2	Roll No.: 16010122323	Experiment / assignment / tutorial No.: 8

Title: 4:1 Mux in VHDL

Objective: Design of 3-bit asynchronous counter using JK flip flop in VHDL

Expected Outcome of Experiment:

CO2: Use different minimization technique and solve combinational circuits, synchronous & asynchronous sequential circuits.

CO4: Implement digital networks using VHDL

Books/ Journals/ Websites referred:

- VLab Links: http://vlabs.iitb.ac.in/vlabs-dev/labs/dldesignlab/experimentlist.html
- R. P. Jain, "Modern Digital Electronics", Tata McGraw Hill
- M .Morris Mano, "Digital Logic & computer Design", PHI
- https://wiki.engr.illinois.edu/download/attachments/84770821/08-Multiplexers.pdf?version=2&modificationDate=1285128827000

Pre Lab/ Prior Concepts:

Multiplexer: Multiplexer is a special type of combinational circuit. It is a digital circuit which selects one of the n data inputs and routes it to the output. The selection of one of the n inputs is done by the select lines. To select n inputs, we require m select lines, such that 2^m=n. Depending on the digital code applied at the select inputs, one out of the n data sources is selected and transmitted to a single output. E is called as the strobe or enable input which is useful for cascading. It is generally on active low terminal that means it will perform the required operation when it is low. The multiplexer act like a digitally controlled single pole, multiple way switches. The output gets connected to only one input at a time. In most of the electronic system the digital data is available on more than one line. It is necessary to route the data over a single line, under such circumstances input at a time.

Types of Multiplexers:

1. 2:1 Multiplexer
2. 4:1 Multiplexer
3. 8:1 Multiplexer
4. 16:1 Multiplexer
5. 32:1 Multiplexer

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Implementation Details of 4:1 MUX

```vhdl
library Ieee;
use ieee.std_logic_1164.all;
use
 ieee.std_logic_unsigned.all;
use ieee.std_logic_arith.all;
entity Mux_2_4 is
 port(    a,b,c,d: in
 std_logic;
    --sel : in integer range
 0 to 3; --when we use if
 then statement.
    sel: in std_logic_vector
 (1 downto 0); --when we use
 when statement.
    z: out std_logic );
end Mux_2_4;
architecture Mux_2_4_arch of
 Mux_2_4 is
begin
 --process (a,b,c,d,sel)
    --begin
              z<=a when
 sel= "00"
              else b when
 sel= "01"
              else c when
 sel="10"
              else d when
 sel="11";
    --if (sel = 0) then z<=a;
        --elsif (sel=1)
 then z<=b;
        --elsif (sel=2)
 then z<=c;
        --elsif (sel=3)
 then z<=d;
    --end if;
 --end process;
end Mux_2_4_arch;
library Ieee;
use ieee.std_logic_1164.all;
use
 ieee.std_logic_unsigned.all;
use ieee.std_logic_arith.all;
entity Mux_2_4_tb is
end Mux_2_4_tb;
architecture Mux_2_4_arch_tb
 of Mux_2_4_tb is
component Mux_2_4 is
 port(
    a,b,c,d: in std_logic;
```
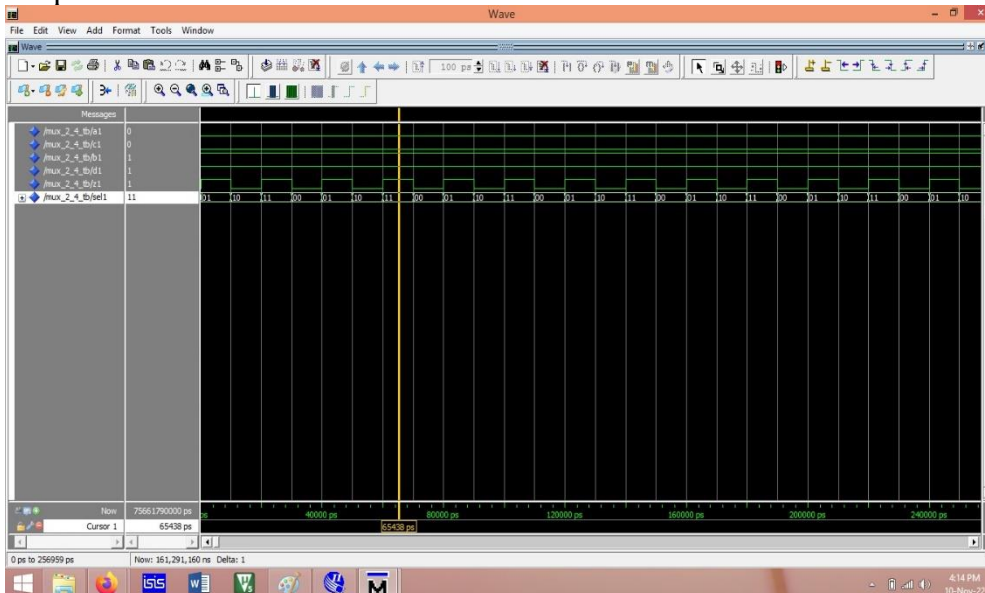
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```
    sel:in std_logic_vector
 (1 downto 0);
    z: out std_logic
   );
end component;
signal        a1,c1:
 std_logic := '0';
signal        b1,d1:
 std_logic := '1';
signal        z1:
 std_logic;
signal sel1 :
 std_logic_vector (1 downto
 0) :="00";
begin
    u1: Mux_2_4 port
 map(a1,b1,c1,d1,sel1,z1);
    process
        begin
            for i in 0 to
 3 loop
              sel1<=
 sel1+1;
              wait for
 10ns;
            end loop;
    end process;
end architecture;
```

Output:

Conclusion: VHDL program for basic logic gates has been run and simulation obtained as required.

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Post Lab Descriptive Questions

1. **Application Mux?**

   Multiplexer are used in various fields where multiple data need to be transmitted using a singleline. Following is some of the applications of multiplexers –

   ▪ **Communication System** – Communication system is a set of system that enable communication like transmission system, relay and tributary station, and communication network. The efficiency of communication system can be increased considerably using multiplexer. Multiplexer allow the process of transmitting different type of data such as audio, video at the same time using a single transmission line.

   ▪ **Telephone Network** – In telephone network, multiple audio signals are integrated on asingle line for transmission with the help of multiplexers. In this way, multiple audio signals can be isolated and eventually, the desire audio signals reach the intended recipients.

   ▪ **Computer Memory** – Multiplexers are used to implement huge amount of memory into the computer, at the same time reduces the number of copper lines required to connect thememory to other parts of the computer circuit.

   ▪ **Transmission from the Computer System of a Satellite** – Multiplexer can be used for the transmission of data signals from the computer system of a satellite or spacecraft to theground system using the GPS (Global Positioning System) satellites.

   This is just an introduction to the concept of Multiplexer. To learn more about Multiplexers, readthis Multiplexer (MUX) and Multiplexing tutorial

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