JAYPEE UNIVERSITY OF ENGINEERING & TECHNOLOGY, GUNA
DEPARMENT OF COMPUTER SCIENCE & ENGINEERING
Course: Computer Organization & Architecture Lab
Course Code: 18B17CI474
B. Tech. (CSE VI Sem.)

Experiment # 1

Aim: Design of All-in-One logic gate circuits.

A *logic gate* is an elementary building block of a digital circuit. It performs a *logical* operation on one or more binary inputs and produces a single binary output 1 or a 0 when its logic requirements are met. The basic *logic gates* are categorized into seven: AND, OR, XOR, NAND, NOR, XNOR and NOT each of these are represented with the help of a distinct graphic symbol. NAND and NOR gates are known as **universal gates** because all other gates can be realized by using these gates. A *logic gate* often uses diodes or transistors that act (in '**on**' and '**off**' states) like electronic switches. Gates receive their input (binary information of 0 or 1) with the aid of physical quantities such as electric signals. For instance, an electric signal of lower voltage (e. g. 0 volts) and of higher voltage (e.g. 5 volts) may be used to represent a binary zero and one respectively. Similarly, the output from gates may be represented using some recognizable states (voltages) of an electric signal. In a computer system, logic gates are used to store the data, perform basic arithmetic/logical operations and other various types of manipulations in the bits.

Exercise#1: Design two inputs and five outputs All-in-One logic gate circuit shown in Fig.1. Write the VHDL code in data flow style of modeling.

Logic diagram

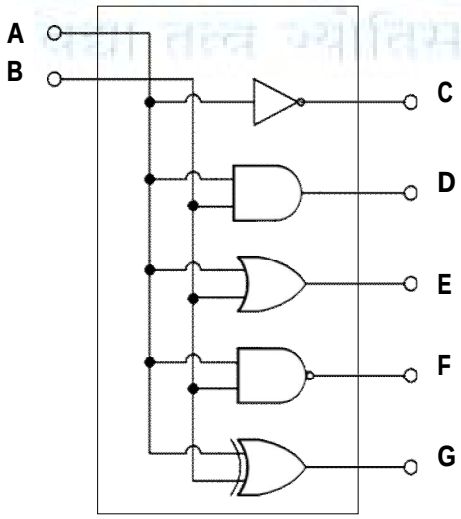

Fig. 1: Two inputs and five outputs All-in-One logic gate diagram.

Truth Table

Inputs		Outputs				
A	B	C	D	E	F	G
0	0	1	0	0	1	0
1	0	0	0	1	1	1
0	1	1	0	1	1	1
1	1	0	1	1	0	0

Boolean Expressions

$$NOT\ gate\colon\ C = \bar{A};\quad AND\ gate\colon\ D = A.B;\ OR\ gate\colon\ E = A + B$$
$$NAND\ gate\colon\ F = \overline{A.B};\qquad XOR\ gate\colon\ G = \bar{A}B + A\bar{B}$$

Exercise#2: Design two inputs and one output All-in-One logic gate diagram shown in Fig.2. Write the VHDL code in behavioral style of modeling using (i) if-then-else (ii) case-when.

This All-in-One logic gate is a double input, single output gate that can be instructed to perform four different logic operations by placing a control value on the inputs X and Y. The instruction to this gate is provided by the operation select bits, which thus determine how the gate will act. Figure 2 shows the block diagram of such a gate. A and B form the data inputs and O the single output. X and Y are the operation select lines. Total number of $\mathbf{2^n}$ functions can be performed with $\boldsymbol{n}$ select lines.

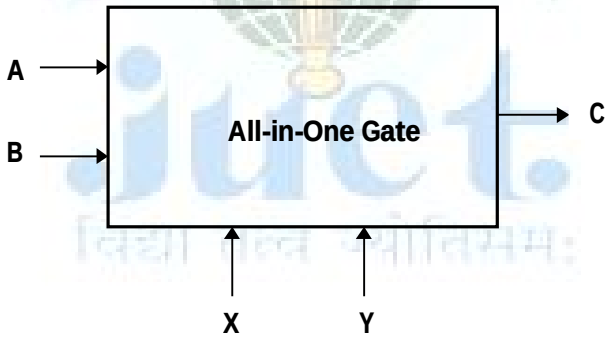

Fig. 2: Two inputs and one outputs All-in-One logic gate block diagram.

Truth Table

Select lines		Functions
X	Y	C
0	0	$AND\ gate\colon\ C = A.B$
1	0	$OR\ gate\colon\ C = A + B$
0	1	$NOR\ gate\colon\ C = \overline{A + B}$
1	1	$NAND\ gate\colon\ C = \overline{A.B}$