Indian Institute of Technology Ropar

Department of Electrical Engineering

EE204 : Digital Circuits Laboratory

Classroom - Analog and Digital Circuits Lab

Introduction:

NAND and NOR gates are considered to be universal gates as they can be used to construct any other logic gates and implement any Boolean function. NAND and NOR gates are essentially complementary logic of AND and OR logics, respectively.

Aim:

Study of universal gates and implementation of Boolean functions using NAND and NOR gates.

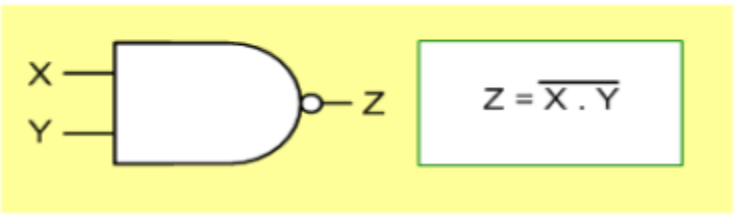
Theory:

NAND:

The NAND gate represents the complement of the AND operation. Its name is an abbreviation of NOT AND. The graphic symbol for the NAND gate consists of an AND symbol with a bubble on the output, denoting that a complement operation is performed on the output of the AND gate.

The truth table and the graphic symbol of NAND gate is shown in the figure.

X	Y	NAND
0	0	1
0	1	1
1	0	1
1	1	0

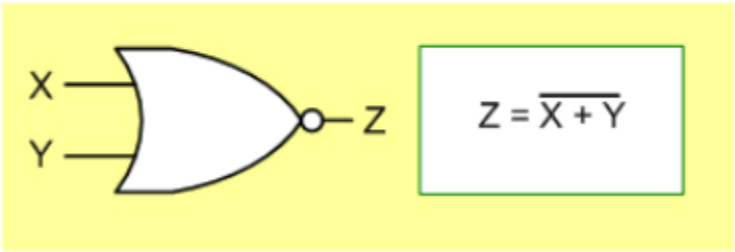


NOR:

The NOR gate represents the complement of the OR operation. Its name is an abbreviation of NOT OR. The graphic symbol for the NOR gate consists of an OR symbol with a bubble on the output, denoting that a complement operation is performed on the output of the OR gate.

The truth table and the graphic symbol of NOR gate is shown in the figure.

X	Y	NOR
0	0	1
0	1	0
1	0	0
1	1	0



Pre-Lab quiz:

Q. State De-Morgan's Laws?

Q. Convert the binary number 011101010001 to octal and hexadecimal?

Q. Write the boolean expressions of all the logic gates.

Procedure:

- The schematic of logic circuits for all basic gates using NAND and NOR are shown in figure 3 and 4 , respectively. Implement the circuits below using TTL 74LS00(NAND) and 74LS02(NOR) ICs.
- For standard input A & B, obtain the corresponding outputs(Y) and verify the truth tables for basic (AND, OR, NOT) and parity (XOR, XNOR) logic gates.
- Find the pin diagrams of ICs at the bottom of the manual.

Fig 3: Logic gates using NAND

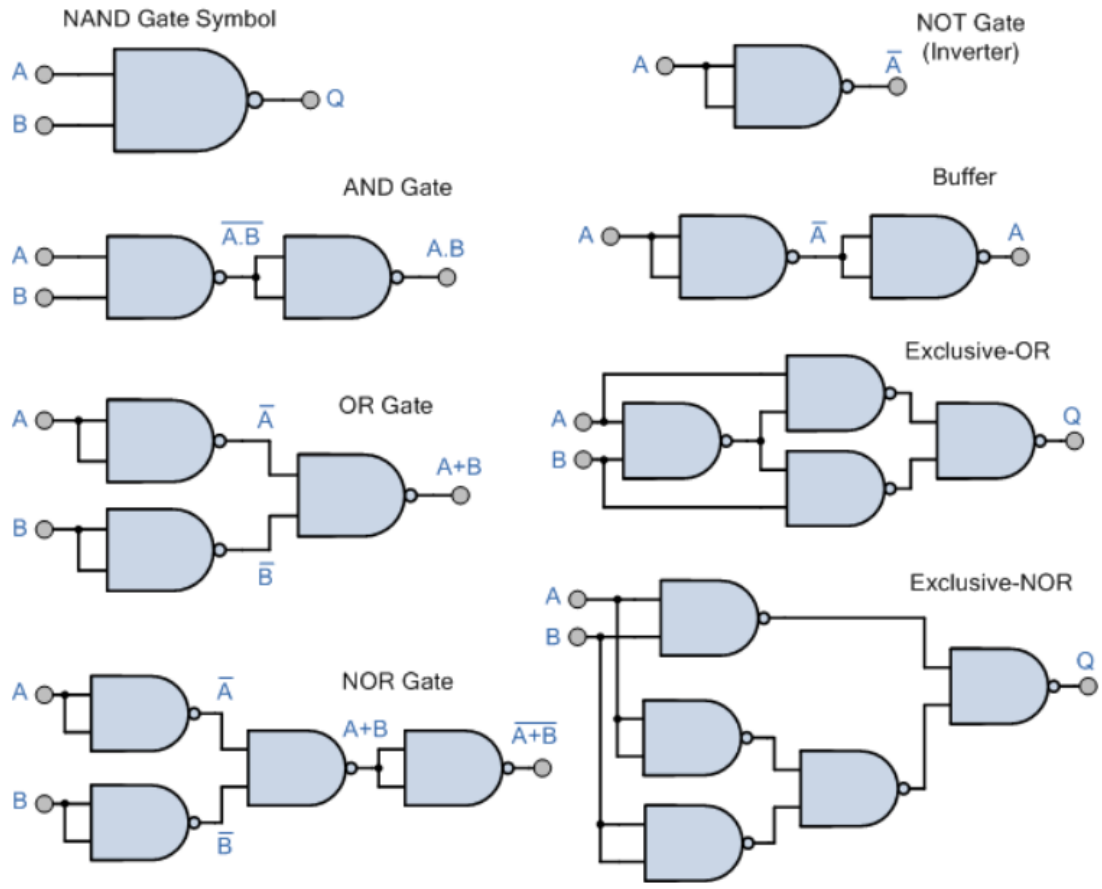
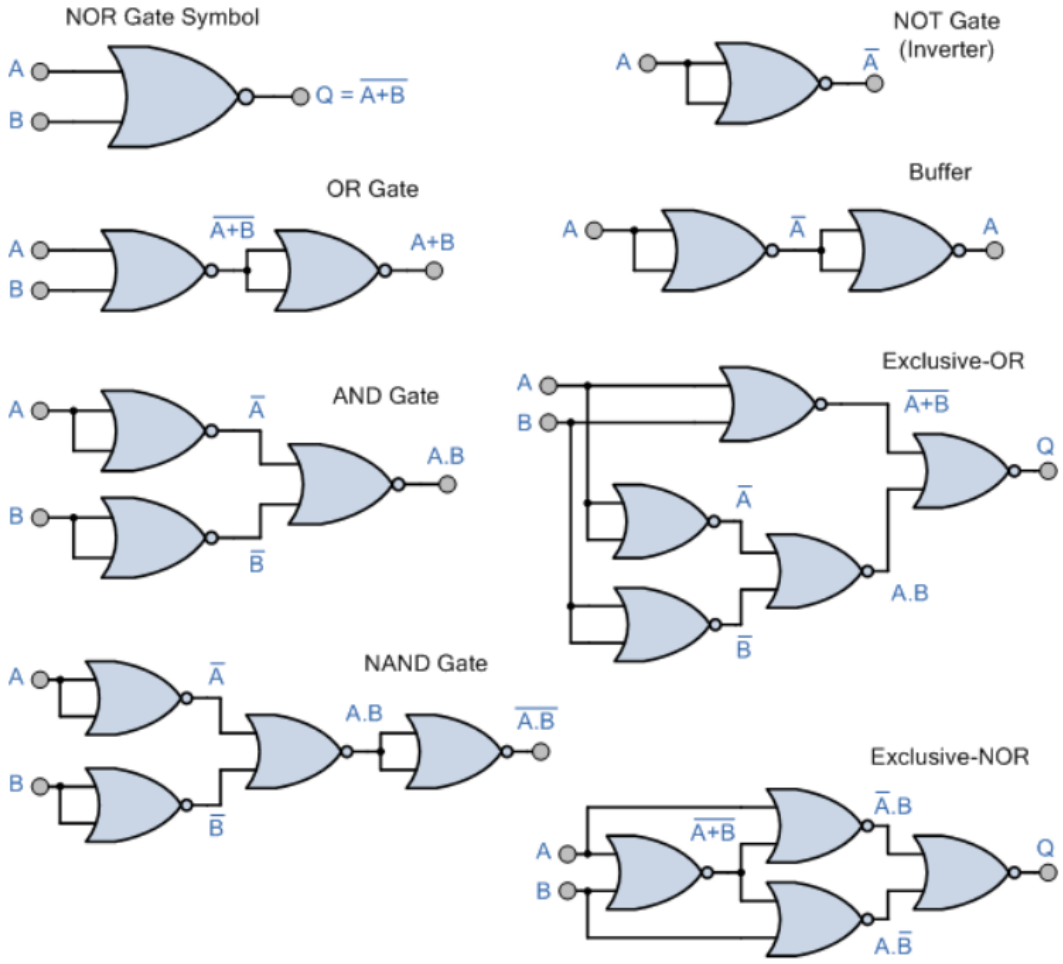


Fig 4: logic gates using NOR



Post-Lab quiz:

Q. If a 3-input NOR gate has eight input possibilities, how many of the possibilities will result in a HIGH output?

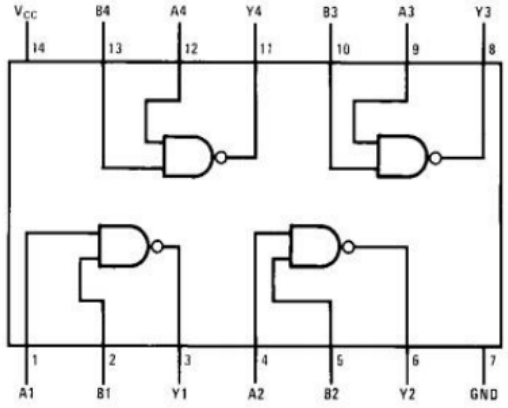
Q. How to obtain the dual of a Boolean equation?

Q. Which logical gate can be used to find out whether the two single bit inputs are equal or not?

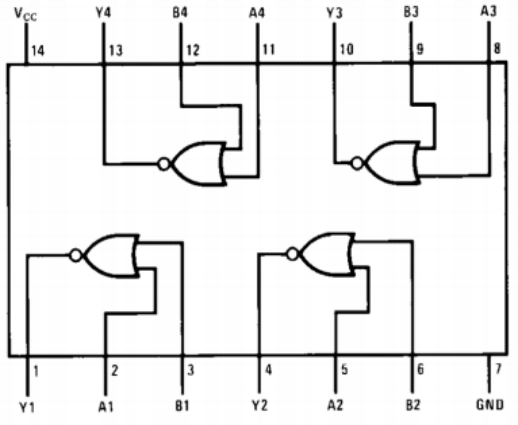
Q. Write a program in *C language and Verilog* to verify the truth tables of these logic gates?

Suggested Readings: Floyd, "Digital Fundamentals", Pearson Education, 2006.

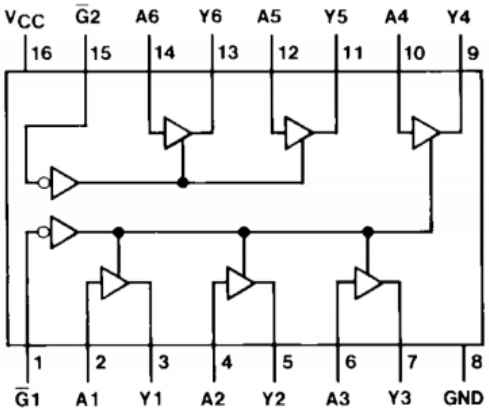
Pin diagram of TTL logic gates



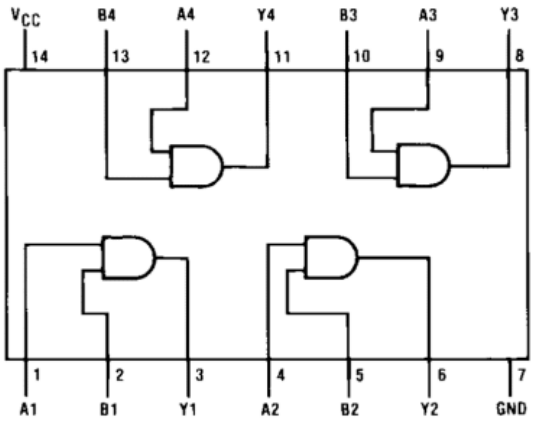
TTL IC 7400: 2-input NAND gate



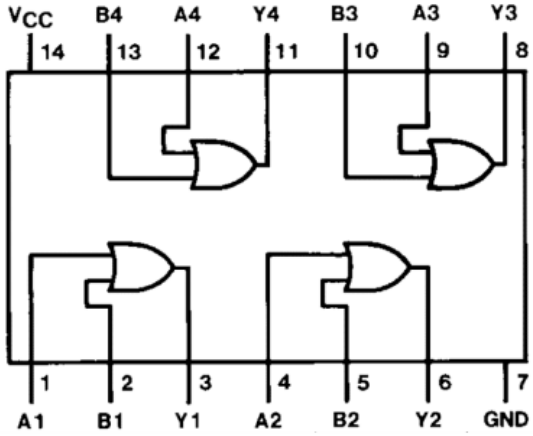
TTL IC 7402: 2-input NOR gate



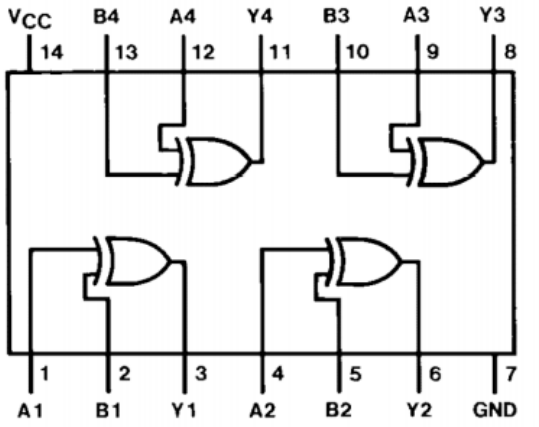
TTL IC 7404: Hex Inverter



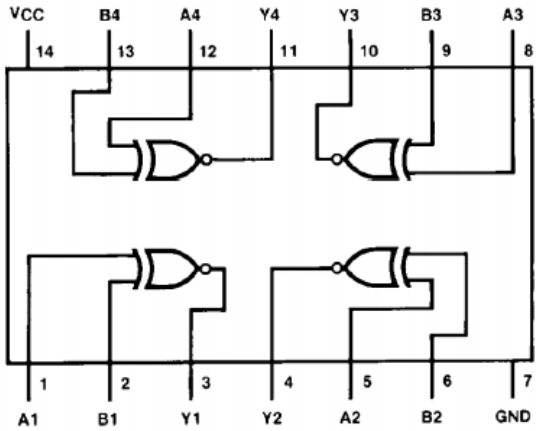
TTL IC 7408: 2-input AND gate



TTL IC 7432: 2-input OR gate



TTL IC 7486: 2-input XOR gate



TTL IC 74266: 2-input XNOR gate