Objectives:

- To study the realization of basic gates using universal gates.
- Understanding how to construct any combinational logic function using NAND or NOR gates only.

Theory:

AND, OR, NOT are called basic gates as their logical operation cannot be simplified further.
NAND and NOR are called universal gates as using only NAND or only NOR, any logic function can be implemented. Using NAND and NOR gates and De Morgan's Theorems different basic gates & EX-OR gates are realized.

Implementing Using Nand Gate:

- INVERTER

```
  O-------
   |
  <-
```

- AND

```
  O-----
   |
  O-----
   |
```

• OR

[Diagrams of OR gate]

• XOR

[Diagrams of XOR gate]

• XNOR

[Diagrams of XNOR gate]

Implementing Using NOR Gate:

• INVERTER

[Diagram of INVERTER]
- **OR**

- **AND**

- **XOR**

- **XNOR**
Lab Work:

Requirements:
IC 7402(NOR), IC 7400(NAND), 7404(NOT), 7408(AND), 7432(OR), KL 33002, power supply, connecting wires and Breadboard etc.

Part 1: Implementation using NAND
- Construct (inv, AND, OR, XOR) gates and check its truth table using NAND ICs (7400) only.
- Repeat using KL 33002 block b.

Part 2: Implementation using NOR
- Construct (inv, OR, AND) gates and check its truth table using NOR ICs (7402) only.
- Repeat using KL 33002 block a.

Exercises:
a) Build a NAND gate using 2 inputs NOR gates (draw logic diagram).
b) Build a NOR gate using 2 inputs NAND gates (draw logic diagram).
c) Implement the following function with NAND gates only (draw logic diagram).
\[ F = (AB' + CD') E + BC (A+B). \]