EXPERIMENT No. 3

AIM: To implement all Logic gates using Universal gate IC-7400 (NAND Gate IC) and IC-7402 (NOR Gate IC).

APPARATUS: Digital trainer kit, Logic gate IC 7400., Connecting wires.

THEORY:

Implementation of all logic gates using universal gate IC-7400 (NAND Gate IC):

Since NAND gate is universal gate, all other logic gates can be implemented using it.

Implementation using NAND gate:

1. **NOT gate:** The input is given into short circuited pins of two inputs NAND gate and the output is inversion of input as shown in fig.
2. **AND gate:** Two NAND gates are required. Inputs given to one NAND gate produce an output which acts as input for second NAND gate and the final output is same as AND gate output.
3. **OR gate:** Three NAND gates are required. Two inputs are given to two different NAND gates the outputs of these are given as input to third NAND gate. Final output is same as of OR gate output.
4. **XOR gate:** Four NAND gates are required. The connections are made as per the given circuit diagram, the final output is same as XOR gate output.
5. **XNOR gate:** Five NAND gates are required. So, we use two 7400 ICs. The final output of XOR gate (Four gates) is given as input to fifth NAND gate and the output is same as XNOR gate i.e., XNOR is inversion of XOR.

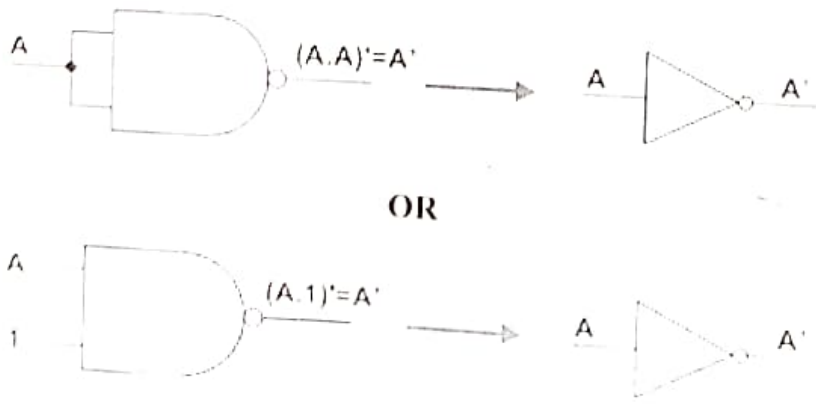

Fig 3.1: NOT Gate Using NAND Gate

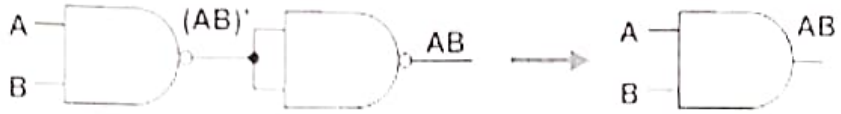

Fig 3.2: AND Gate Using NAND Gate

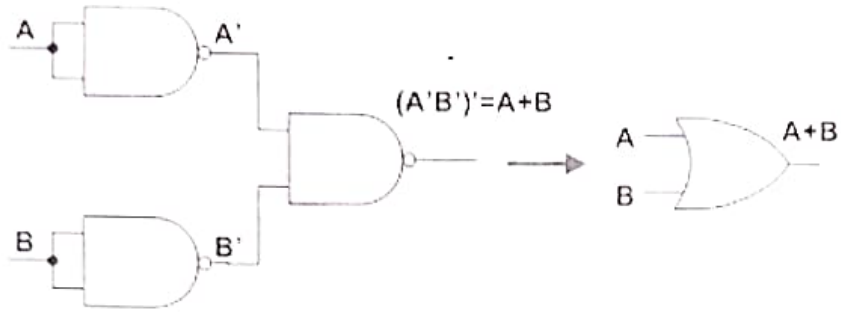

Fig 3.3: OR Gate Using NAND Gate

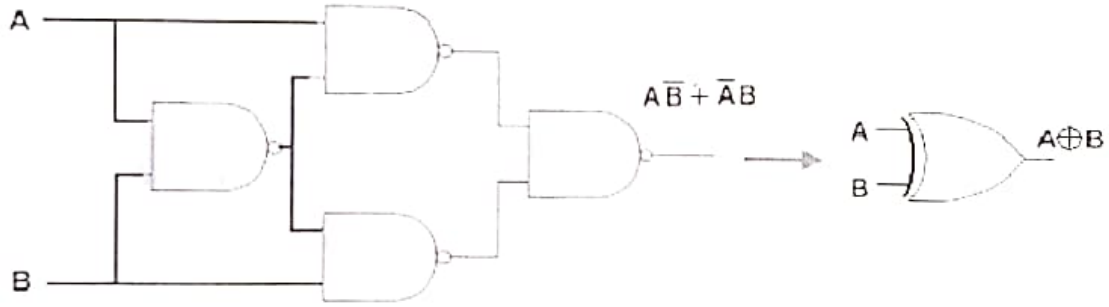

Fig 3.4: EX-OR Gate Using NAND Gate

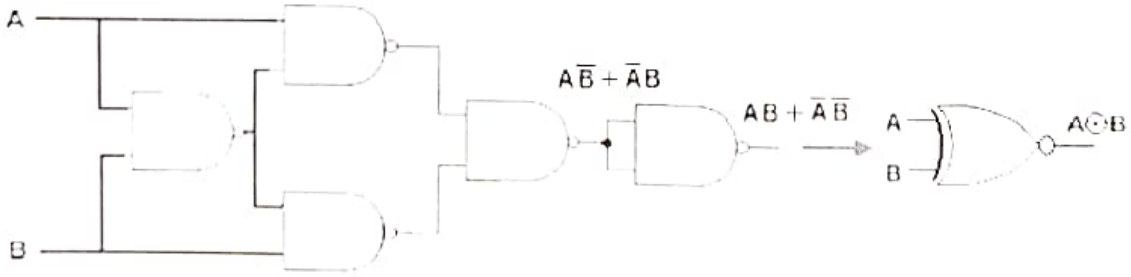

Fig 3.5: EX-NOR Gate Using NAND Gate

PIN DESCRIPTION:

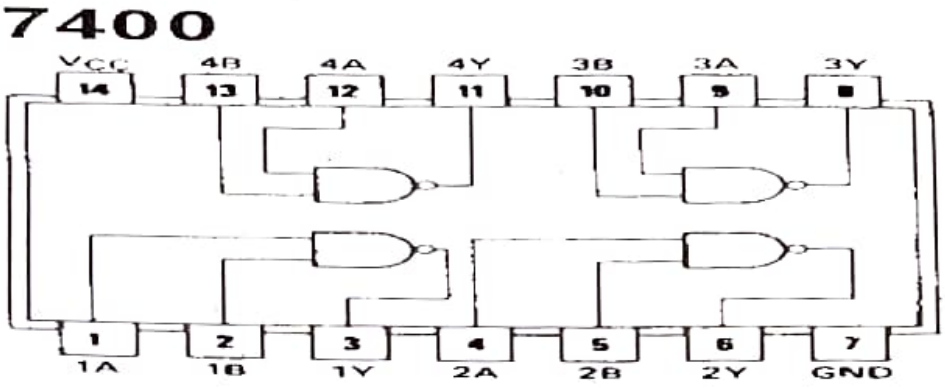

Fig 3.6: IC 7400 (NAND GATE)

PROCEDURE:

1. Take a 14 pin NAND gate IC, a trainer kit which must be switched off and some wires.
2. Insert the IC into the 14 pin IC slot in the trainer kit.
3. Now make the connection one by one as given circuit diagrams and pin description.
4. Make ground connection and Vcc connection for voltage supply.
5. In the kit LEDs are attached with the input toggle switches and output. At low value (0) of switch LED do not glow or LED glow Green, while at high value (1) switch LED glow Red.
6. By changing inputs using toggle switches verify truth tables for all circuits.

Implementation of all logic gates using universal gate IC-7402 (NOR Gate IC):

Since NOR gate is universal gate, all other logic gates can be implemented using it.

Implementation using NOR gate:

1. **NOT gate:** The input is given into short circuited pins of two inputs NOR gate and the output is inversion of input as shown in fig.
2. **AND gate:** Two NOR gates are required. Inputs given to one NOR gate produce an output which acts as input for second NOR gate and the final output is same as AND gate output.
3. **OR gate:** Three NOR gates are required. Two inputs are given to two different NOR gates the outputs of these are given as input to third NOR gate. Final output is same as of OR gate output.
4. **XOR gate:** Four NOR gates are required. The connections are made as per the given circuit diagram, the final output is same as XOR gate output.
5. **XNOR gate:** Five NOR gates are required. So, we use two 7402 ICs. The final output of XOR gate (Four gates) is given as input to fifth NOR gate and the output is same as XNOR gate i.e., XNOR is inversion of XOR.

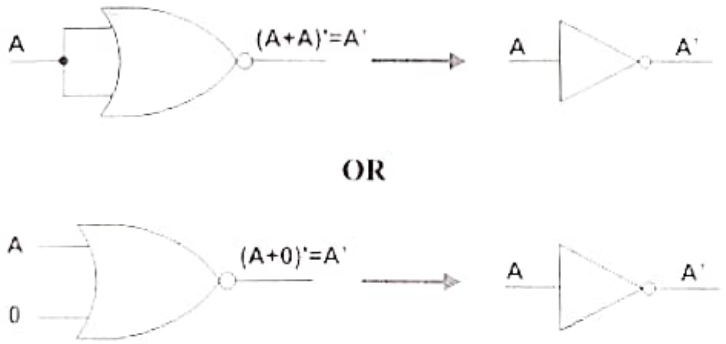

Fig 3.7: NOT Gate Using NOR Gate

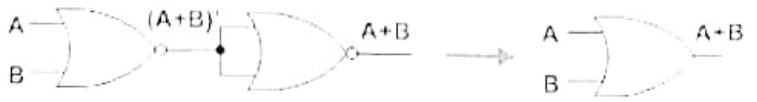

Fig 3.8: OR Gate Using NOR Gate

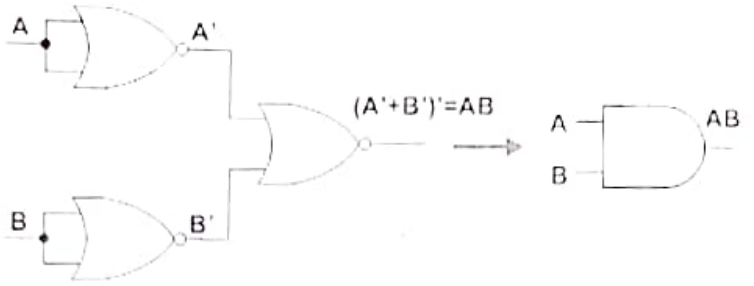

Fig 3.9: AND Gate Using NOR Gate

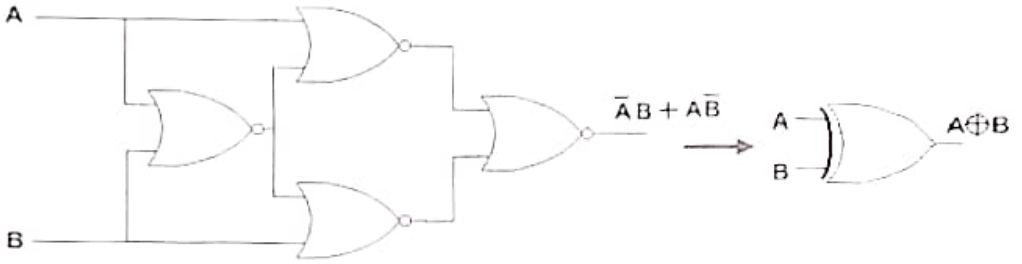

Fig 3.10: EX-OR Gate Using NOR Gate

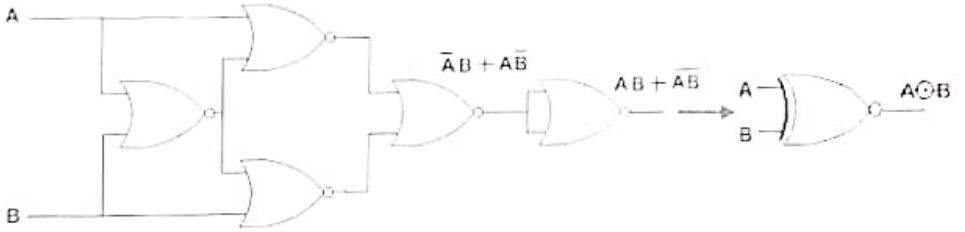

Fig 3.11: EX-NOR Gate Using NOR Gate

Pin Description:

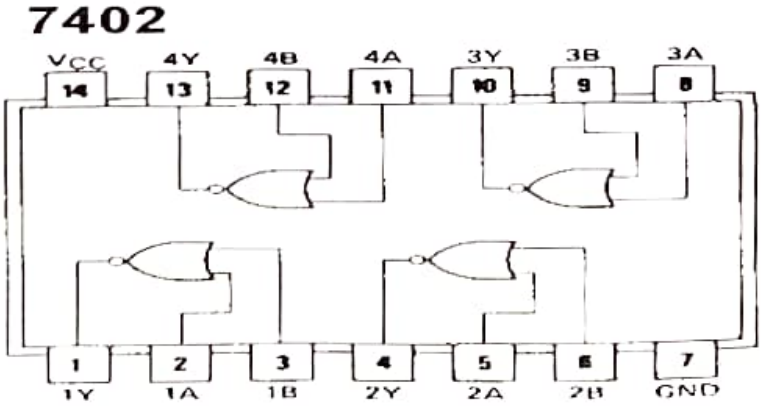

Fig 3.12: IC 7402 (NOR GATE)

PROCEDURE:

1. Take a 14 pin NOR gate IC, a trainer kit which must be switched off and some wires.
2. Insert the IC into the 14 pin IC slot in the trainer kit.
3. Now make the connection one by one as given circuit diagrams and pin description.
4. Make ground connection and Vcc connection for voltage supply.
5. In the kit LEDs are attached with the input toggle switches and output. At low value (0) of switch LED do not glow or LED glow Green, while at high value (1) switch LED glow Red.
6. By changing inputs using toggle switches verify truth tables for all circuits.

PRECAUTIONS:

1. Circuit should be properly connected.
2. Do not short circuit in the trainer kit during operation.
3. Wires should be held by their heads while being removed else they may get damage.