C.V. RAMAN POLYTECHNIC BHUBANESWAR

DEPARTMENT OF ELECTRONICS AND TELECOMMUNICATION ENGINEERING

LAB MANUAL

Year & Semester:2nd Year,4th Semester

Subject Code/Name: PR- 3***,*** Digital Electronics Lab

Digital

Electronics

Lab

LABORATORY WORK INSTRUCTION		DEPARTMENT: ELECTRONICS AND TELECOMMUNICATION ENGG.
Date of Preparation: 20-12-2010	Prepared by : *Jully Das.* Verified by :	Counter Signature of the HOD :
Semester:4th	Branch : Electrical.	Name of the Practical with Code :`Digital Electronics Lab(PR-2)

Name of the Experiment: Familiarization of digital trainer kit-AET-21

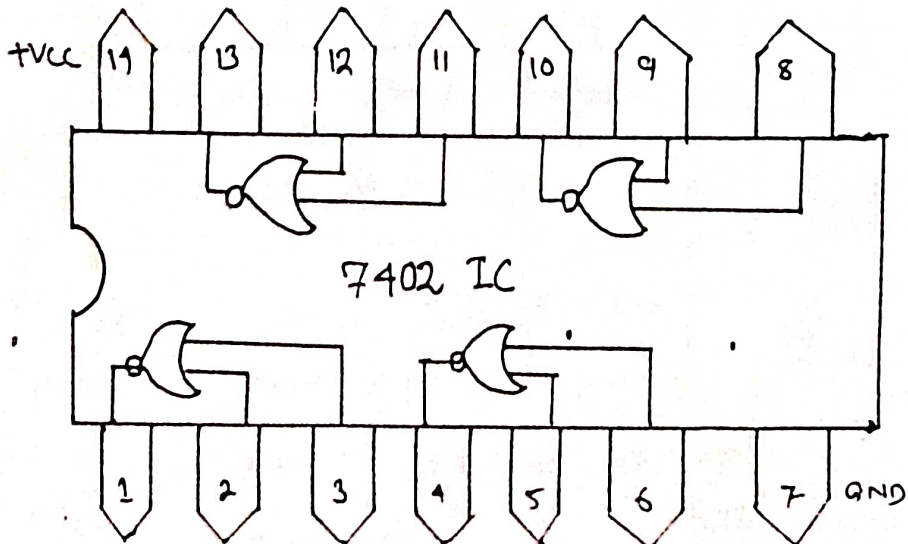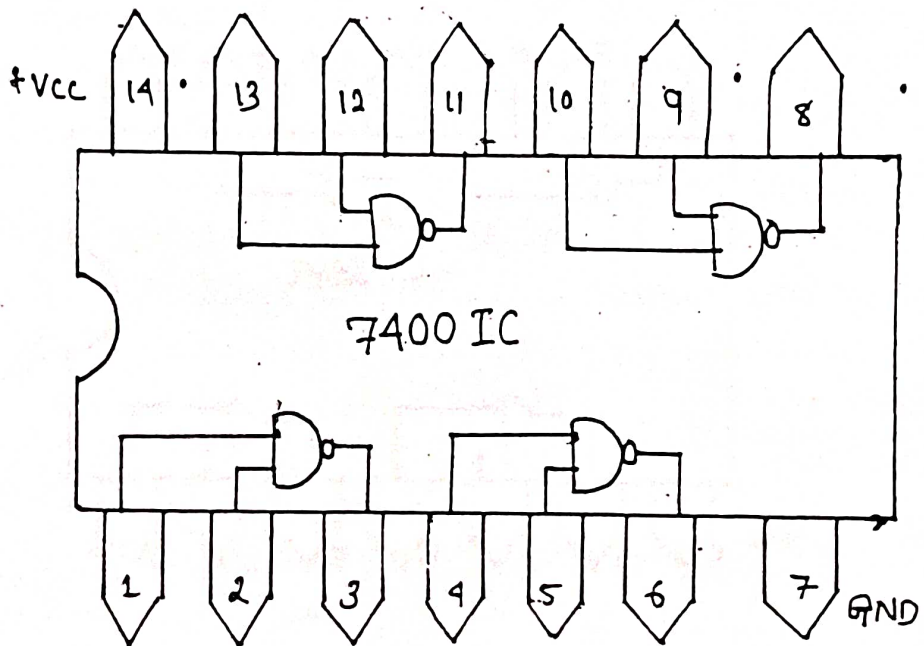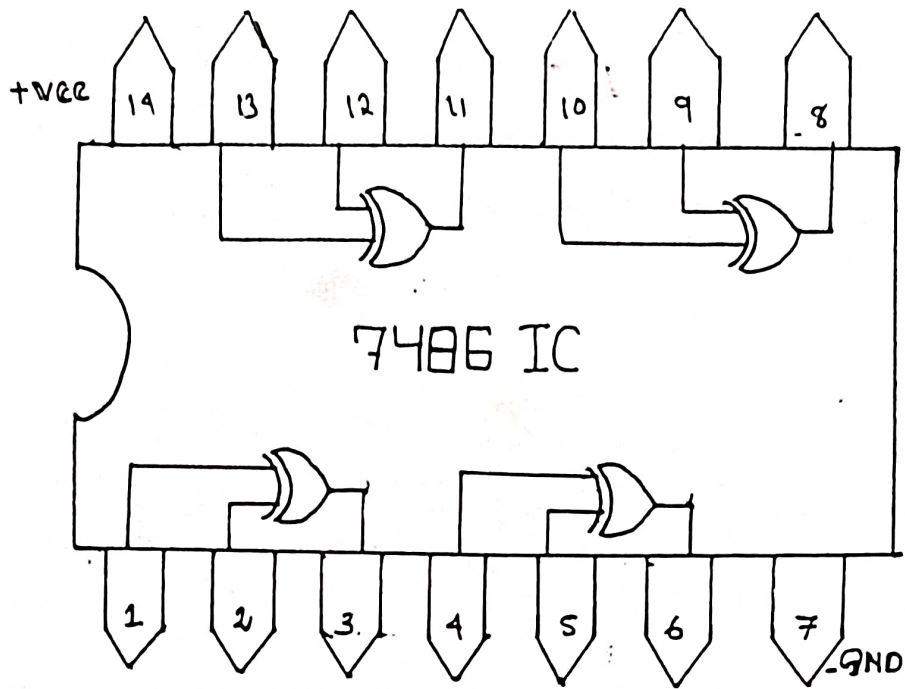## EQUIPMENT/TOOLS/ACCESSORIES REQUIRED :

- Basic Logic Trainer Kit-AET-21
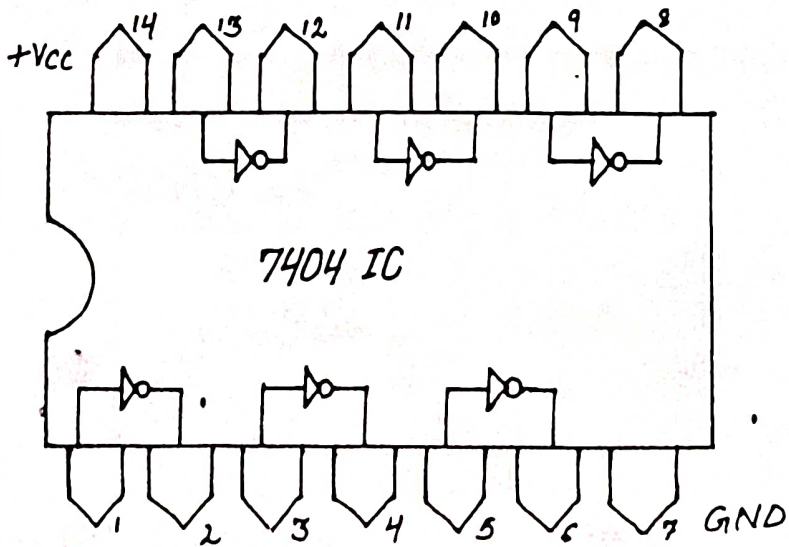- IC-7400, IC-7402, IC-7404, IC-7408, IC-7432, IC-7486.

PROCEDURE :

- Take the IC 7400.
- Study the no of pins present in it.
- Study the +VCC & GND pins.
- Point out the other pins following the internal circuit diagram of the above ICs.
- Follow the above procedure for the above ICs.

SAFETY AND PRECAUTIONS , IF ANY :

- Do not connect the IC to any other power supply.
- Handle it carefully.

+Vcc 14 13 12 11 10 9 8

7486 IC

1 2 3 4 5 6 7 GND

+Vcc 14 13 12 11 10 9 8

7400 IC

1 2 3 4 5 6 7 GND

+Vcc 14 13 12 11 10 9 8

7402 IC

1 2 3 4 5 6 7 GND

+VCC 14 13 12 11 10 9 8

7408 IC

1 2 3 4 5 6 7 GND

+VCC 14 13 12 11 10 9 8

7432 IC

1 2 3 4 5 6 7 GND

+VCC 14 13 12 11 10 9 8

7404 IC

1 2 3 4 5 6 7 GND

LABORATORY WORK INSTRUCTION		DEPARTMENT: ELECTRONICS AND TELECOMMUNICATION ENGG.
Date of Preparation: 20-12-2010	Prepared by : _Jully Das._ Verified by :	Counter Signature of the HOD :
Semester 4th	Branch : Electrical.	Name of the Practical with Code : Digital Electronics Lab(PR-2)

Name of the Experiment: Verify the truth tables of AND , OR ,NOT,NOR, NAND,XOR,XNOR Gates.

EQUIPMENT/TOOLS/ACCESSORIES REQUIRED :

- Basic Logic Trainer Kit-AET-21
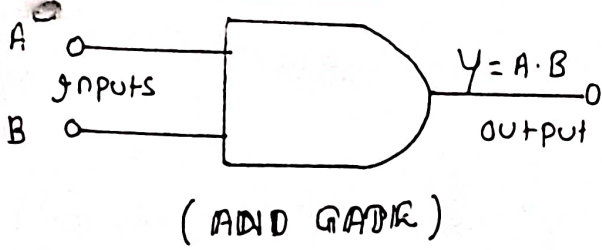- Connecting Wires.

PROCEDURE :

- Take a basic logic trainer kit (AET-21)
- Draw the truth table.
- Draw the logical diagram by solving the truth table.
- Connect the kit according to logic diagram.
- Switch on the kit.
- Verify the truth table by giving logical zero or one from logic input switches connected to the input of the gates and output is found at logic indicators connected to the output.
- If indicator glows then it represents logic 1 and if not then it is taken as logic 0.
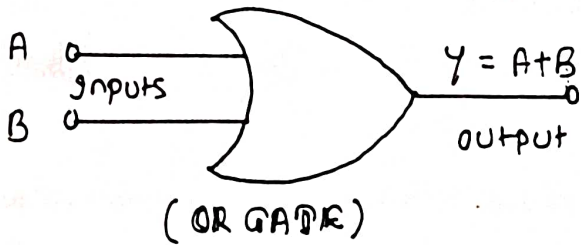
SAFETY AND PRECAUTIONS , IF ANY :

- After connections of all connectors then only switch on the power supply.
- Do not disconnect the IC during operation.
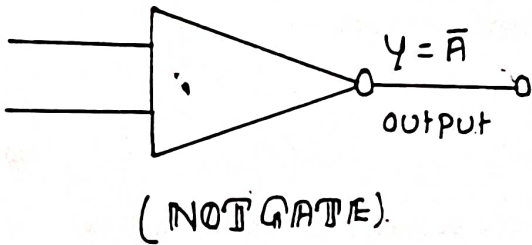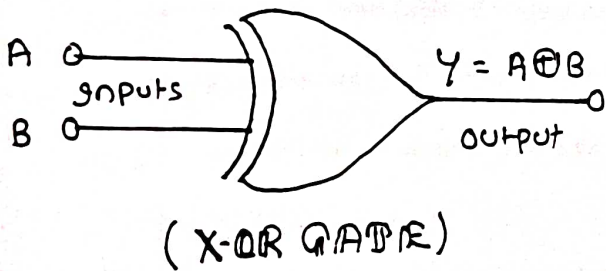- Handle it carefully.

LOGIC GATES

A ─○ ⊐ inputs
B ─○ ⊐ $Y = A \cdot B$ output

(AND GATE)

A ─○ ⊐ inputs
B ─○ ⊐ $Y = A + B$ output

(OR GATE)

$Y = \bar{A}$ output

(NOT GATE)

A ─○ inputs
B ─○ $Y = A \oplus B$ output

(X-OR GATE)

A ─○ inputs
B ─○ $Y = \overline{A \cdot B}$

(NAND GATE)

A ─○
B ─○ $Y = \overline{A + B}$

(NOR GATE)

A ─○
B ─○ $Y = A \odot B$

(X-NOR GATE)

TRUTH TABLE

INPUTS		OUTPUT
A	B	$Y = A \cdot B$
0	0	0
0	1	0
1	0	0
1	1	1

INPUTS		OUTPUT
A -	B -	$Y = A + B$
0	0	0
0	1	1
1	0	1
1	1	1

input	output
A	$Y = \bar{A}$ -
0	1
1	0

INPUTS		OUTPUT
A	B	$Y = A \oplus B$
0	0	0
0	1	1
1	0	1
1	1	0
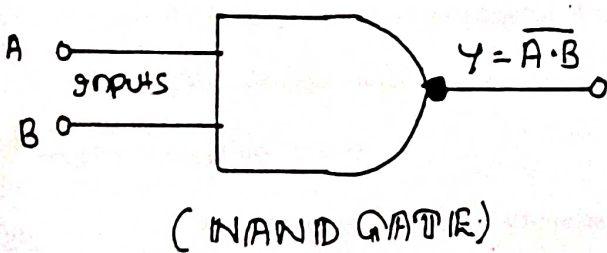
INPUTS		OUTPUT
A	B	$Y = \overline{A \cdot B}$
0	0	01
0	1	1
1	0	1
1	1	0
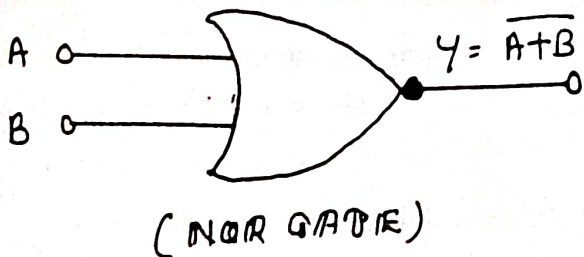
INPUTS		OUTPUT
A	B	$Y = \overline{A + B}$
0	0	1
0	1	0
1	0	0
1	1	0

INPUTS		OUTPUT
A	B	$Y = A \odot B$
0	0	1
0	1	0
1	0	0
1	1	1

LABORATORY WORK INSTRUCTION		DEPARTMENT: ELECTRONICS AND TELECOMMUNICATION ENGG.
Date of Preparation: 20-12-2010	Prepared by : *Kulay Das.* Verified by :	Counter Signature of the HOD :
Semester: 4th	Branch : Electrical	Name of the Practical with Code : Digital Electronics Lab(PR-2)

Name of the Experiment: Implement various Gates by using universal properties of NAND and NOR Gates, Verify the truth tables.

EQUIPMENT/TOOLS/ACCESSORIES REQUIRED :

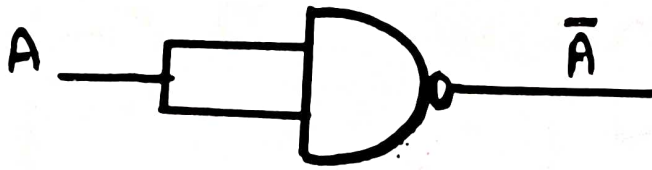- Basic Logic Trainer Kit-AET-21
- Connecting Wires.

PROCEDURE :

- Take a basic logic trainer kit (AET-21)
- Draw the truth table of individual basic gates.
- Draw the logical diagram of each basic gates by implementing the property of Universal Gates.
- Connect the kit according to logic diagram.
- Switch on the kit.
- Verify the truth table of each gate by giving logical zero or one from logic input switches connected to the input of the gates and output is found at logic indicators connected to the output.
- If indicator glows then it represents logic 1 and if not then it is taken as logic 0.
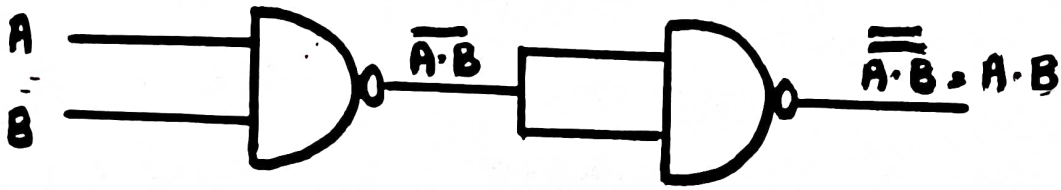
SAFETY AND PRECAUTIONS , IF ANY :

- After connections of all connectors then only switch on the power supply.
- Do not disconnect the IC during operation.
- Handle it carefully.

REALIZATION OF LOGIC GATES BY USING NAND GATE
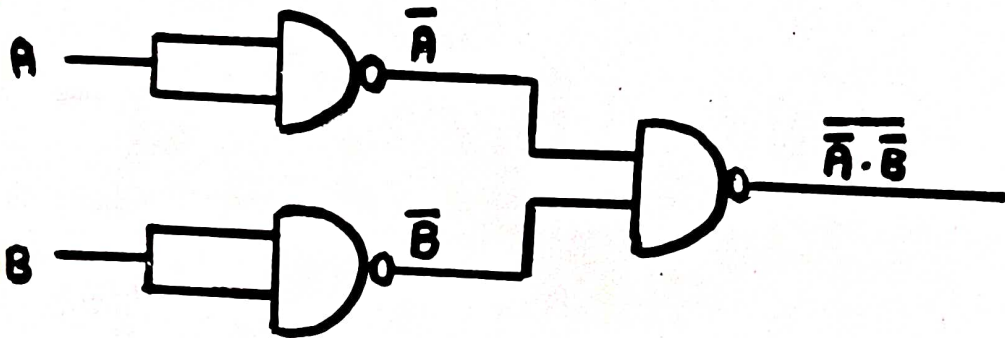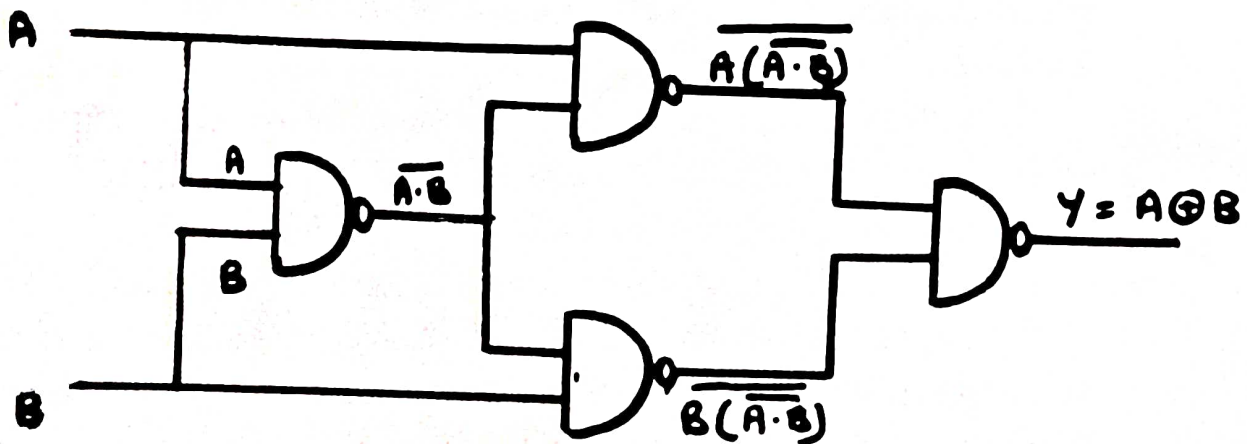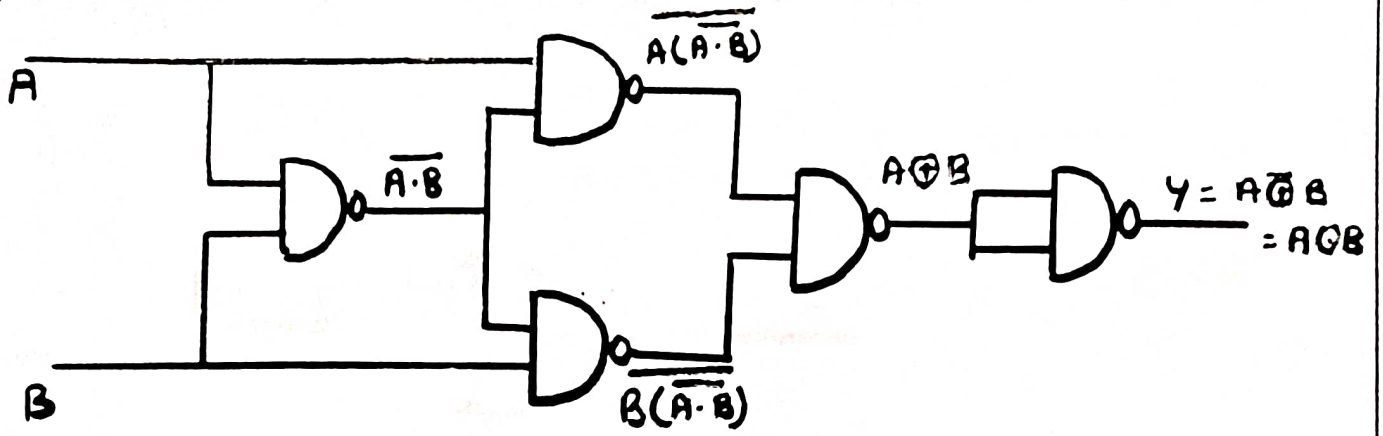
$$A \longrightarrow \overline{A}$$

(NOT GATE)

$$A, B \longrightarrow \overline{A \cdot B} \longrightarrow \overline{\overline{A \cdot B}} = A \cdot B$$

(AND GATE)

$$A \longrightarrow \overline{A}$$
$$B \longrightarrow \overline{B} \longrightarrow \overline{\overline{A} \cdot \overline{B}}$$

(OR GATE)

$$A, B \longrightarrow \overline{A \cdot B}, \overline{A(\overline{A \cdot B})}, B(\overline{A \cdot B}), Y = A \oplus B$$

(EX-OR GATE)

A

$\overline{A \cdot B}$

$\overline{A(\overline{A \cdot B})}$

B

$\overline{B(\overline{A \cdot B})}$

$A \oplus B$

$Y = A \overline{\oplus} B$
$= A \odot B$
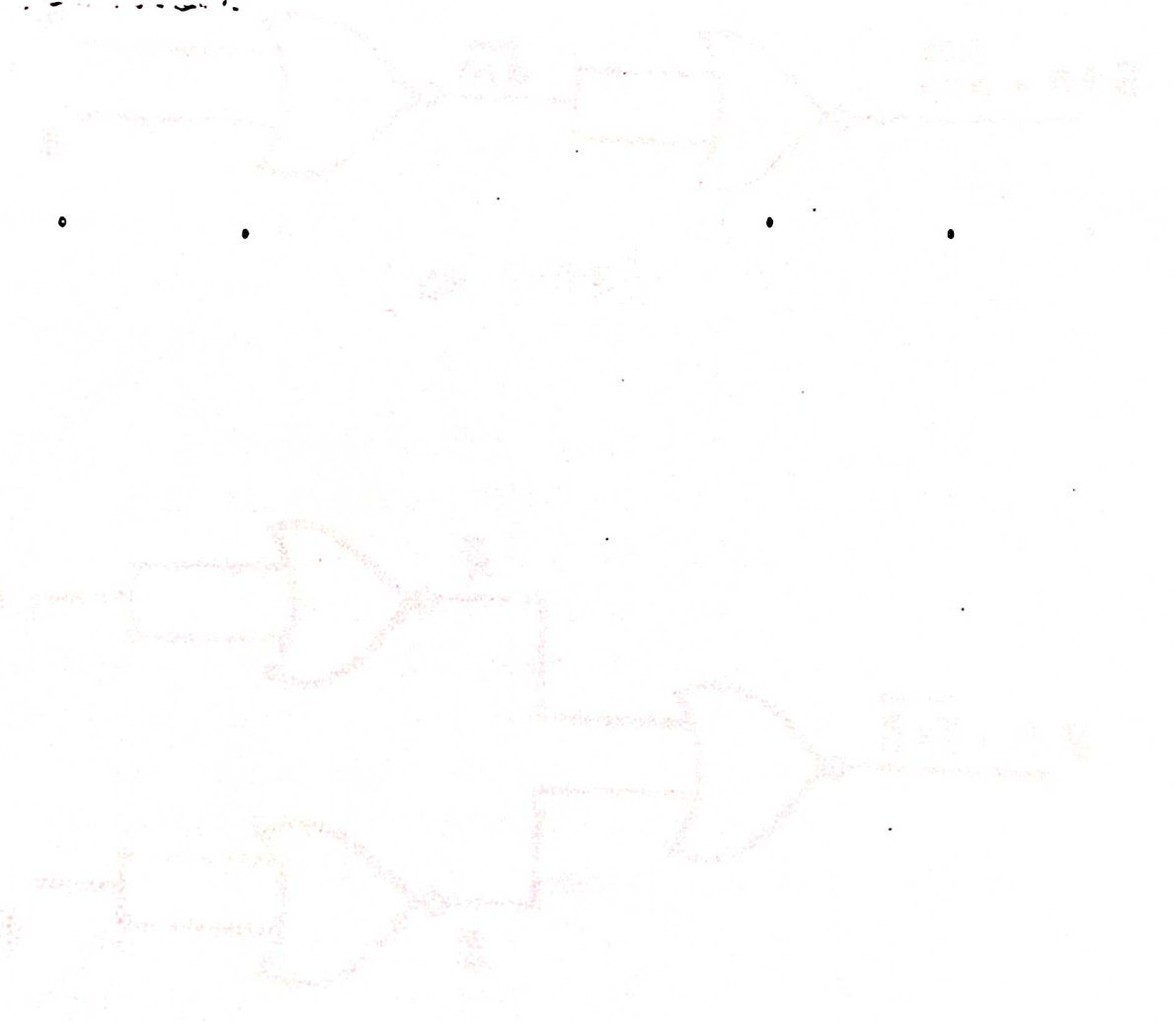
(EX - NOR GATE).

REALIZATION OF LOGIC GATES BY USING NOR GATES

A — $\overline{A}$

(NOT. GATE)

A, B — $\overline{A+B}$ — $\overline{\overline{A+B}} = A+B$

(OR - GATE)

A — $\overline{A}$

B — $\overline{B}$

$\overline{\overline{A}+\overline{B}} = A \cdot B$

(AND . GATE)

A

$\overline{A+B}$

$A + \overline{(\overline{A+B})}$

$B + \overline{(A+B)}$

B

$Y = A \oplus B$

(Ex-OR GATE).

A

$\overline{A+B}$

$\overline{A + \overline{(A+B)}}$

$\overline{B + (\overline{A+B})}$

B

$Y = A \odot B$
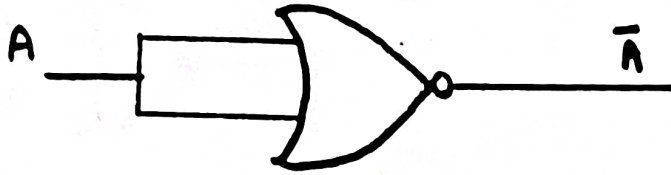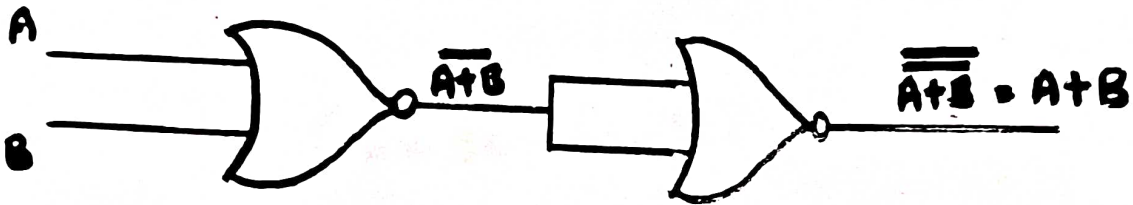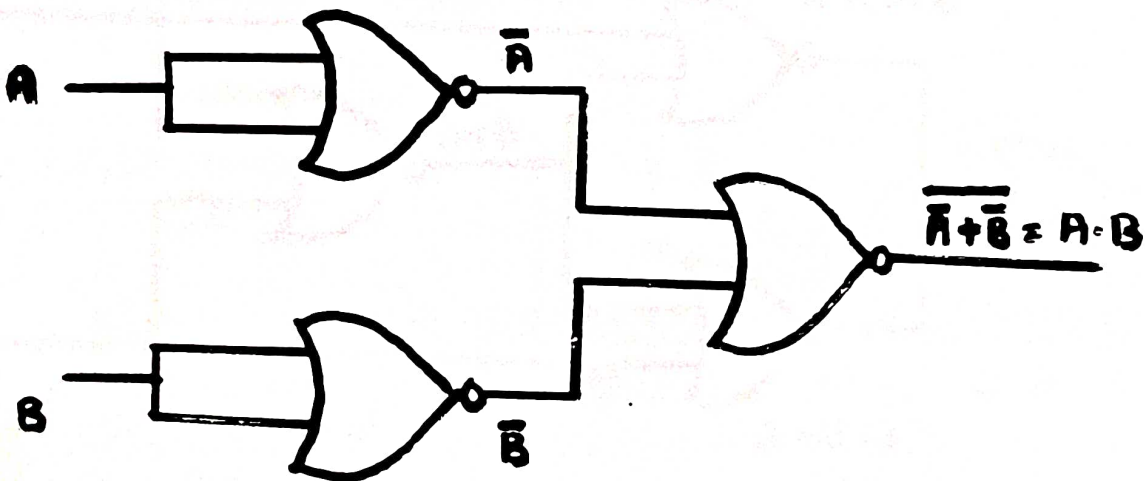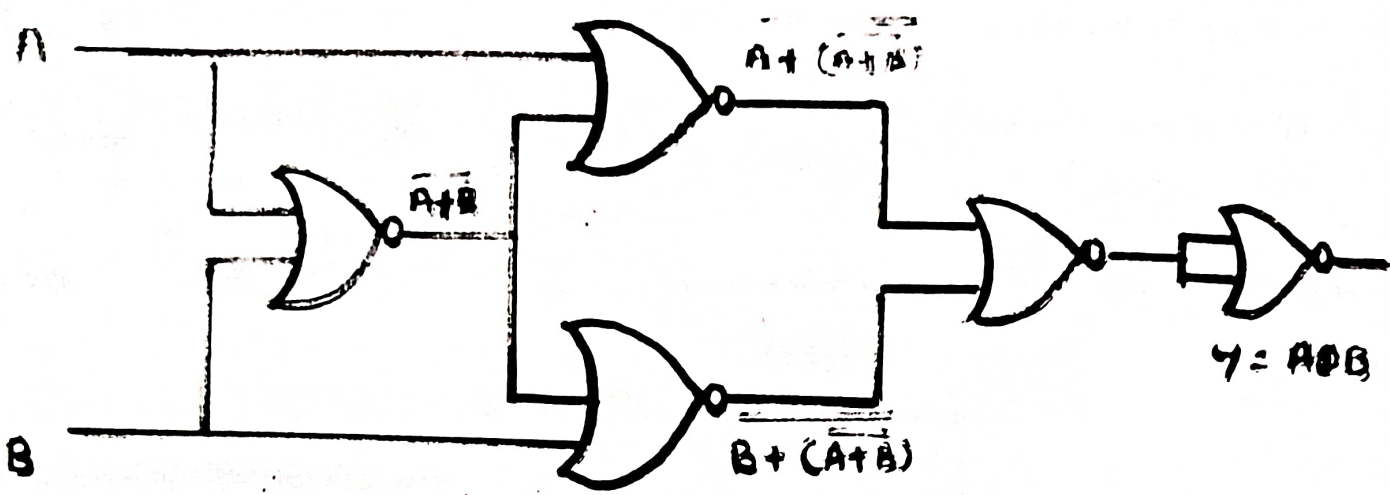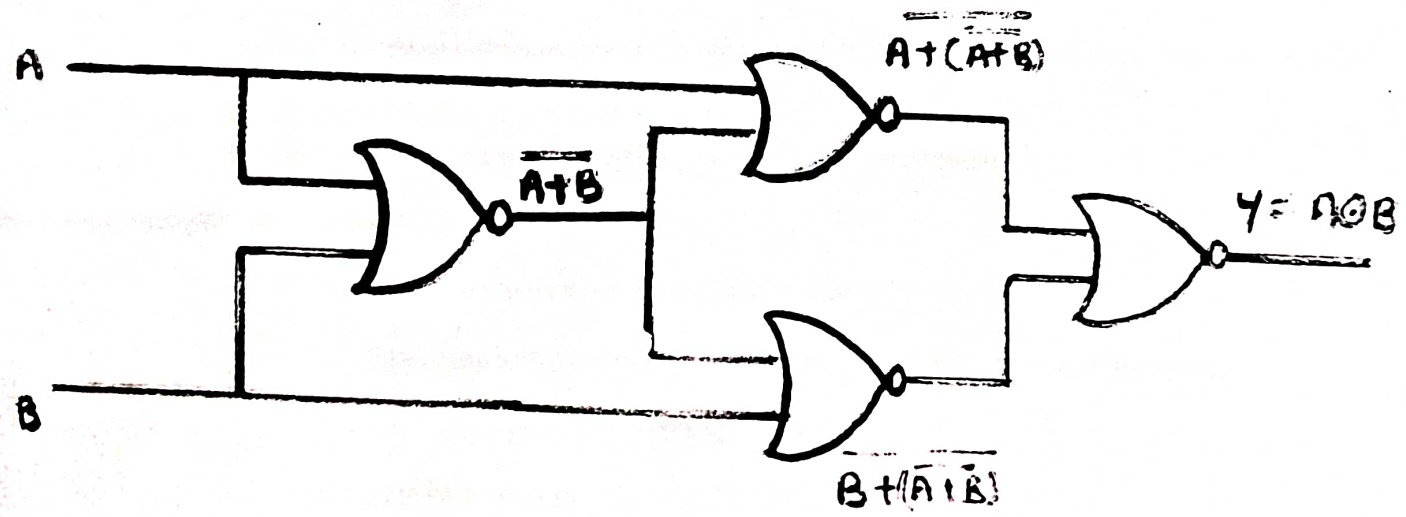
(Ex-NOR GATE).

LABORATORY WORK INSTRUCTION		DEPARTMENT: ELECTRONICS AND TELECOMMUNICATION ENGG.
Date of Preparation: 20-12-2010	**Prepared by :** Jully Das. **Verified by :**	**Counter Signature of the HOD :**
Semester: 4th	Branch : Electrical	Name of the Practical with Code : Digital Electronics Lab(PR-2)

Name of the Experiment: Verify the truth table of Half adder & Full adder using logic circuits.

EQUIPMENT/TOOLS/ACCESSORIES REQUIRED :

- Basic Logic Trainer Kit-AET-21
- Connecting Wires.

PROCEDURE :

- Draw the truth table for difference and borrow.
- From the truth table design the logic diagram for the above.
- According to the logic diagram connect the logic trainer kit (AET-21)
- Before giving the supply check the circuit again.
- Operate the input switch in different states i.e. (00,01,10,11) and check the output by the help of indicator LED .
- Confirm about the output by checking the result with truth table.

SAFETY AND PRECAUTIONS , IF ANY :

- Do not connect the IC to any power supply directly.
- After connections of all connectors then only switch on the power supply.
- Don't disconnect the IC during operation.
- Handle it carefully.

CKT DIAGRAM FOR HALF ADDER :-

TRUTH TABLE FOR HALF ADDER :-

INPUT		OUTPUT	
A	B	S	C
0	0	0	0
0	1	1	0
1	0	1	0
1	1	0	1

CKT DIAGRAM FOR FULL ADDER.
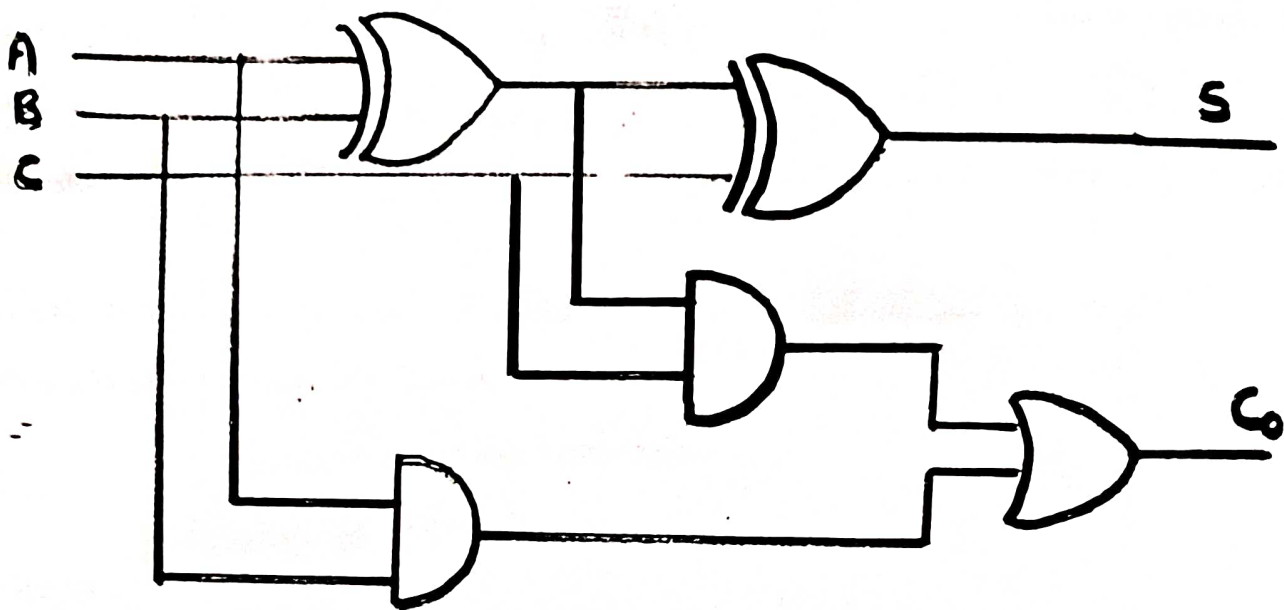
TRUTH TABLE FOR FULL ADDER :-

Inputs			Output	
A	B	C	S	C
0	0	0	0	0
0	0	1	1	0
0	1	0	1	0
0	1	1	0	1
1	0	0	1	0
1	0	1	0	1
1	1	0	0	1
1	1	1	1	1

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Name of the Experiment: Verify the truth table of Half subtractor & Full subtractor using logic circuits.

EQUIPMENT/TOOLS/ACCESSORIES REQUIRED :

- Basic Logic Trainer Kit-AET-21
- Connecting Wires.

PROCEDURE :

- Draw the truth table for difference and borrow.
- From the truth table design the logic diagram for the above.
- According to the logic diagram connect the logic trainer kit (AET-21)
- Before giving the supply check the circuit again.
- Operate the input switch in different states i.e. (00,01,10,11) and check the output by the help of indicator LED .
- Confirm about the output by check the result with truth table.

SAFETY AND PRECAUTIONS , IF ANY :

- Do not connect the IC to any power supply directly.
- After connections of all connectors then only switch on the power supply.
- Don't disconnect the IC during operation.
- Handle it carefully.

CKT DIAGRAM FOR HALF SUBTRACTOR:-
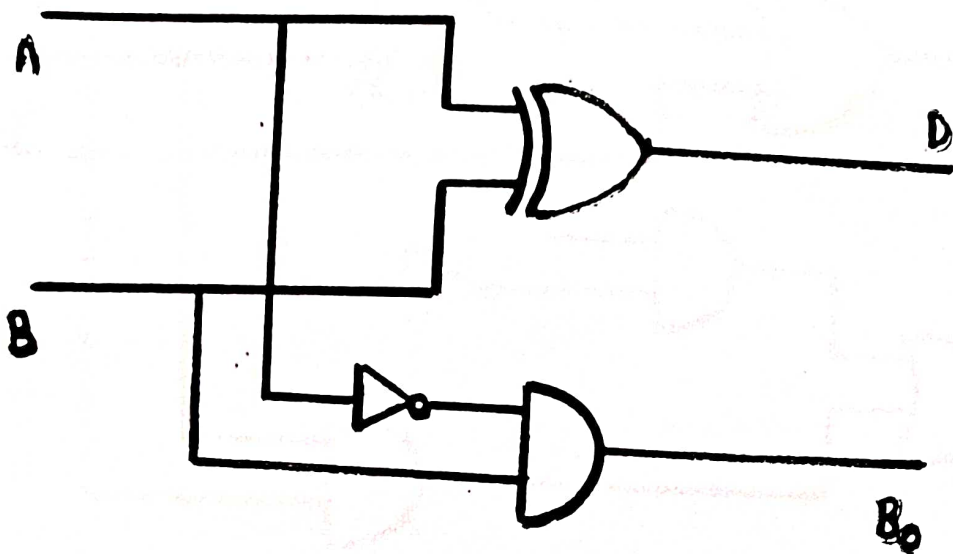
TRUTH TABLE FOR HALF SUBTRACTOR:-

Inputs		Outputs	
A	B	D	Bo
0	0	0	0
0	1	1	1
1	0	1	0
1	1	0	0

(K) DIAGRAM FOR FULL SUBTRACTER :-
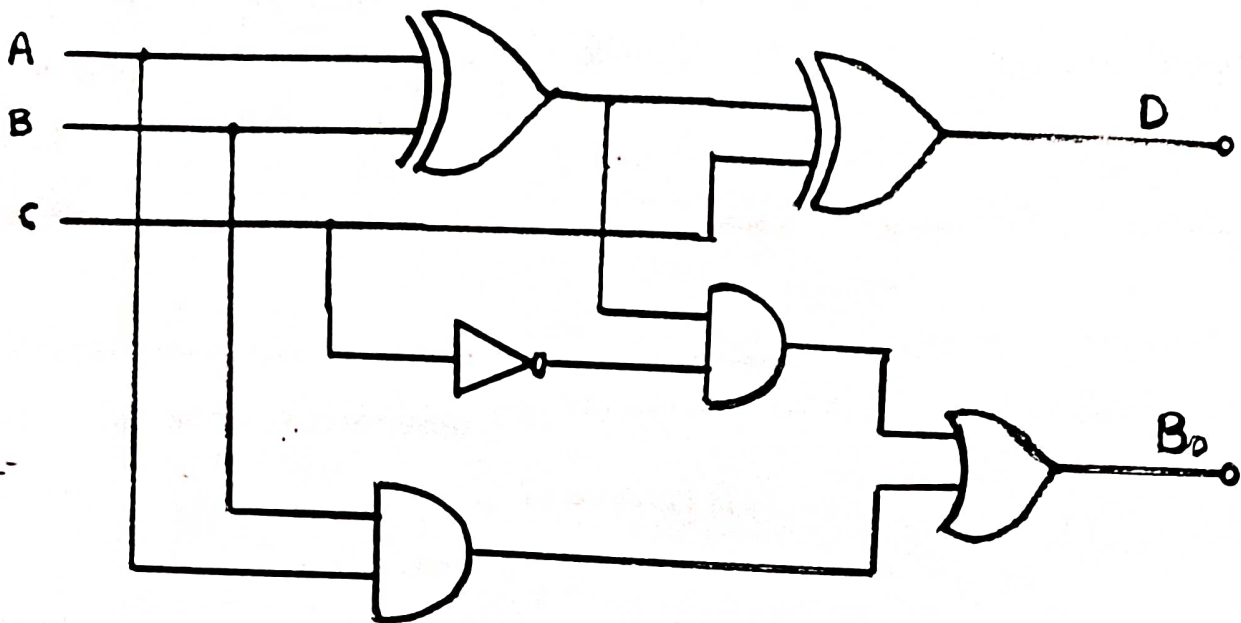
TRUTH TABLE FOR FULL SUBTRACTOR :-

Inputs			Output	
A	B	C	D	Bo
0	0	0	0	0
0	0	1	1	1
0	1	0	1	1
0	1	1	0	1
1	0	0	1	0
1	0	1	0	0
1	1	0	0	0
1	1	1	1	1

LABORATORY WORK INSTRUCTION		DEPARTMENT: ELECTRONICS AND TELECOMMUNICATION ENGG.
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Name of the Experiment: Implement a 4-Bit binary to gray code converter.

EQUIPMENT/TOOLS/ACCESSORIES REQUIRED :

- Basic Logic Trainer Kit-AET-21
- Connecting Wires.

PROCEDURE :

- Draw the truth table for binary to gray code conversion.
- From the truth table design the logic diagram for the above.
- According to the logic diagram connect the logic trainer kit (AET-21)
- Before giving the supply check the circuit again.
- Operate the input switch in different states i.e. (0000 to 1111) and check the output by the help of indicator LED .
- Confirm about the output by check the result with truth table.

SAFETY AND PRECAUTIONS , IF ANY :

- Do not connect the IC to any power supply directly.
- After connections of all connectors then only switch on the power supply.
- Don't disconnect the IC during operation.
- Handle it carefully.
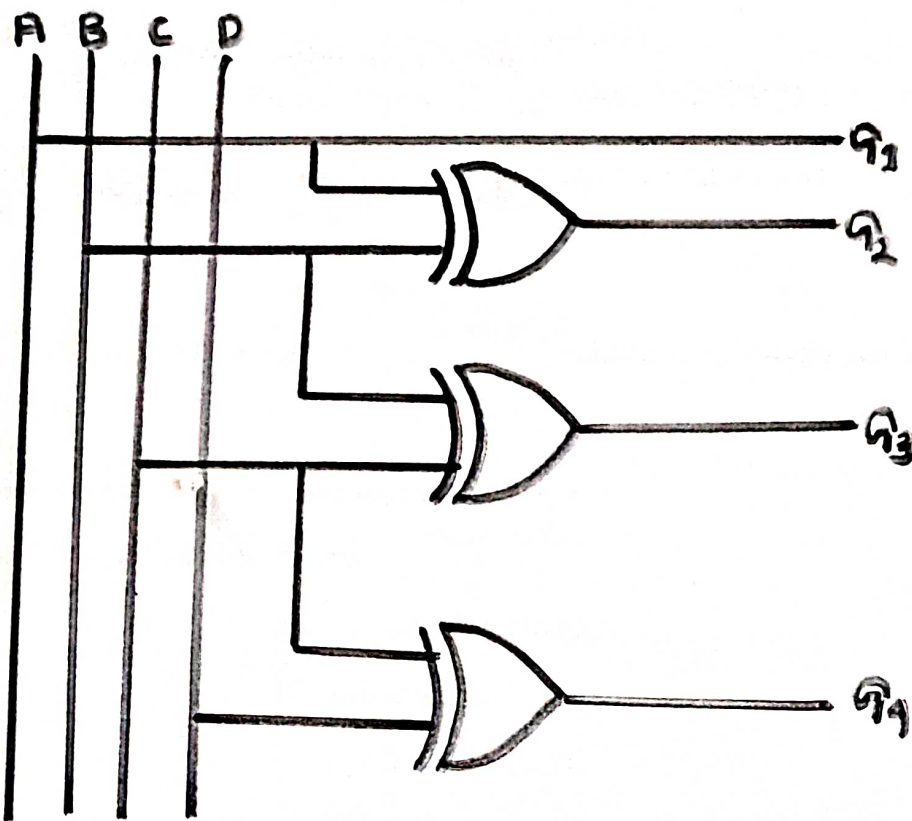
(CKT DIAGRAM FOR BINARY TO GRAY CODE
CONVERSION)

TRUTH TABLE :--

Inputs				Outputs			
B_1	B_2	B_3	B_4	G_1	G_2	G_3	G_4
0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	1
0	0	1	0	0	0	1	1
0	0	1	1	0	0	1	0
0	1	0	0	0	1	1	0
0	1	0	1	0	1	1	1
0	1	1	0	0	1	0	1
0	1	1	1	0	1	0	0
1	0	0	0	1	1	0	0
1	0	0	1	1	1	0	1
1	0	1	0	1	1	1	1
1	0	1	1	1	1	1	0
1	1	0	0	1	0	1	0
1	1	0	1	1	0	1	1
1	1	1	0	1	0	0	1
1	1	1	1	1	0	0	0

LABORATORY WORK INSTRUCTION	DEPARTMENT: ELECTRONICS AND TELECOMMUNICATION ENGG.
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Semester: 4th	**Branch : Electrical**	**Name of the Practical with Code :** Digital Electronics Lab(PR-2)

Name of the Experiment: Implement a single bit digital comparator.

EQUIPMENT/TOOLS/ACCESSORIES REQUIRED :

- Basic Logic Trainer Kit-AET-21

- Connecting Wires.

PROCEDURE :

- Draw the truth Table for single bit digital comparator.

- From the truth table design the logic diagram.

- According to the logic diagram connect the logic trainer kit (AET-21)

- Before giving the supply check the circuit again.

- Operate the input switch in different states i.e. (00,01,10,11) and check the output by the help of indicator LED .

- Confirm about the output by checking the result with truth table.
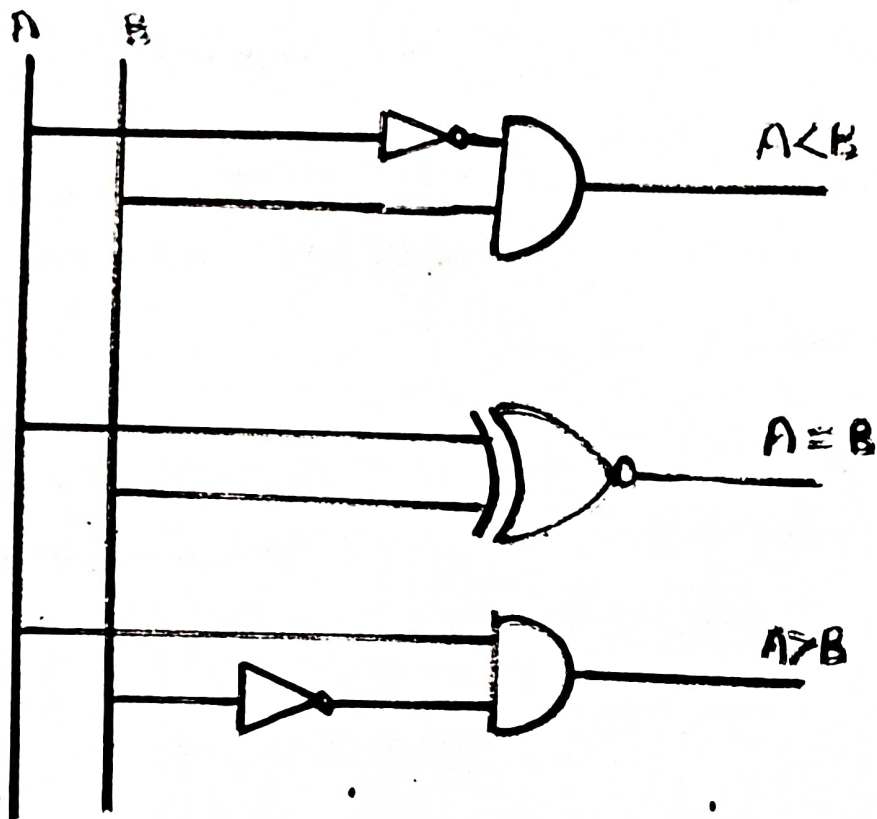
SAFETY AND PRECAUTIONS , IF ANY :

- Do not connect the IC to any power supply directly.

- After connections of all connectors then only switch on the power supply.

- Don't disconnect the IC during operation.

- Handle it carefully.

C.T DIAGRAM FOR SINGLE BIT COMPARATOR :--

TRUTH TABLE FOR SINGLE BIT COMPARATOR :-

Inputs		Outputs		
A	B	A<B	A=B	A>B
0	0	0	1	0
0	1	1	0	0
1	0	0	0	1
1	1	0	1	0

LABORATORY WORK INSTRUCTION		DEPARTMENT: ELECTRONICS AND TELECOMMUNICATION ENGG.
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Semester: 4th	Branch : Electrical	Name of the Practical with Code : Digital Electronics Lab(PR-2)

Name of the Experiment: Study multiplexer and demultiplexer.

EQUIPMENT/TOOLS/ACCESSORIES REQUIRED :

- Multiplexer Trainer Kit (AET-31)
- Connecting Wires.

PROCEDURE :

- Draw the truth Table for multiplexer and demultiplexer separately.
- From the truth table design the logic diagram.
- According to the logic diagram connect the logic trainer kit .
- Before giving the supply check the circuit again.
- Give the input for the selection line and data input line from logic indicator switches.
- Connect the output of mux and demux to output indicators.
- Switch on power supply.
- Confirm about the output by checking the result with truth table.
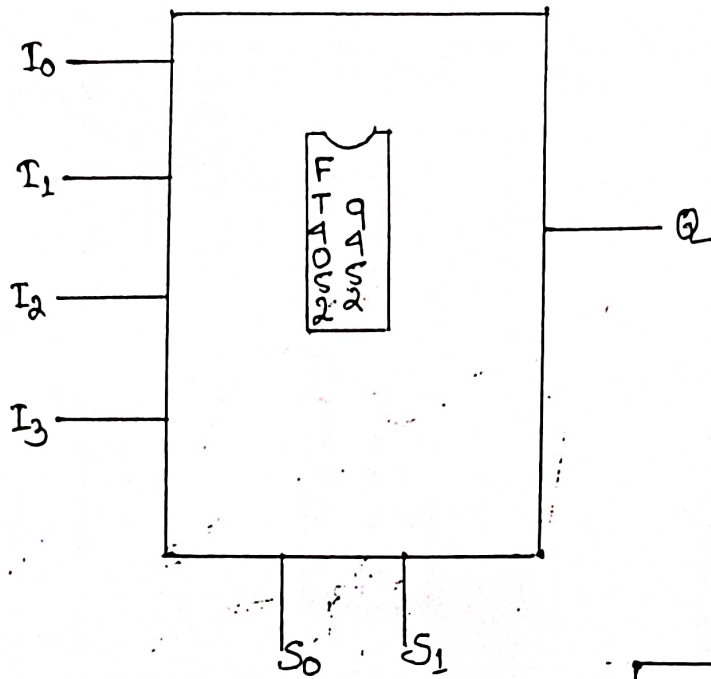
SAFETY AND PRECAUTIONS , IF ANY :

- Do not connect the IC to any power supply directly.
- After connections of all connectors then only switch on the power supply.
- Don't disconnect the IC during operation.
- Handle it carefully.

(4X1 MULTIPLEXER)

Inputs		Output	
S_1	S_0	Q	
0	0	I_0	.
0	1	I_1	
1	0	I_2	
1	1	I_3	
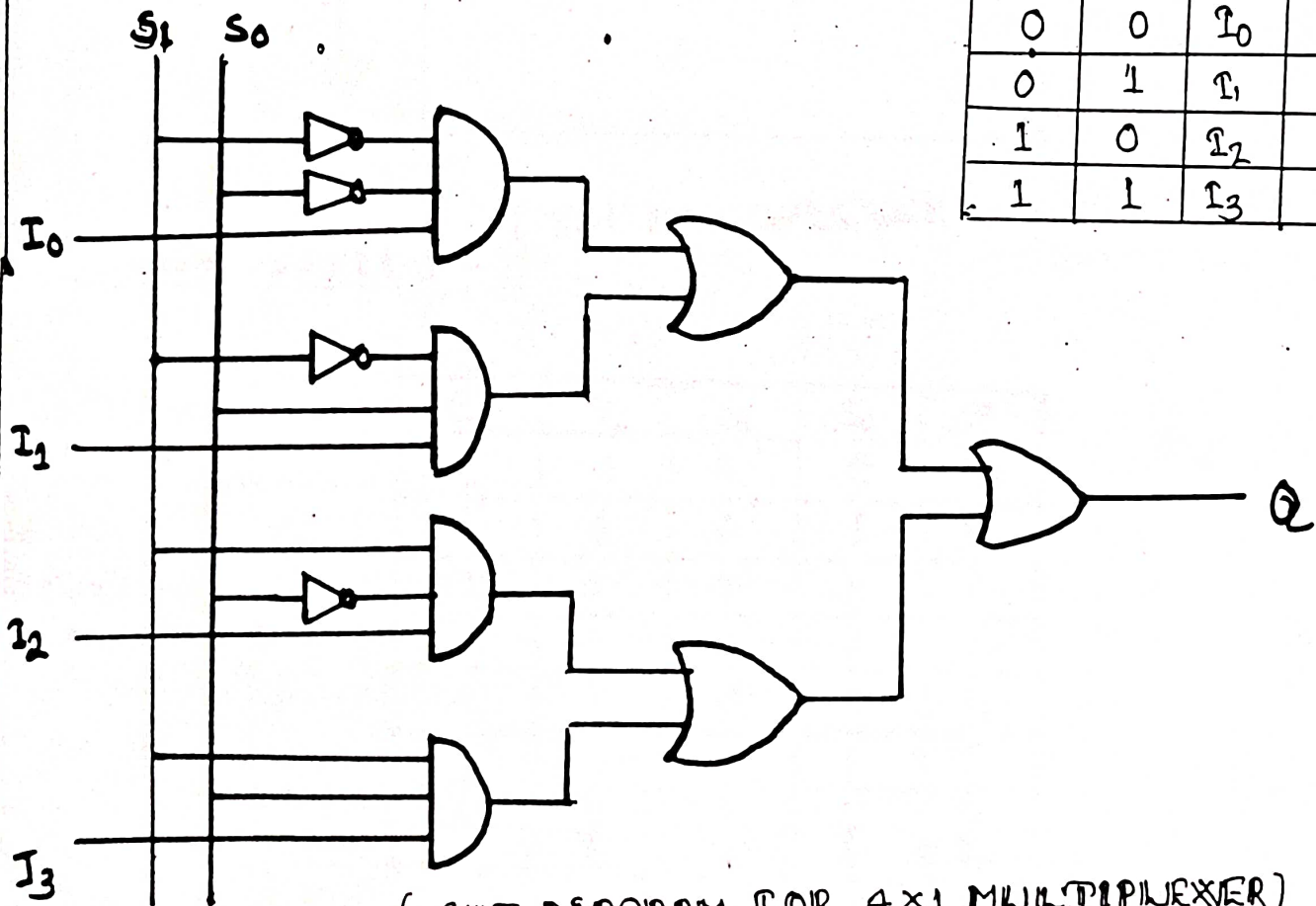
(CKT DIAGRAM FOR 4X1 MULTIPLEXER).
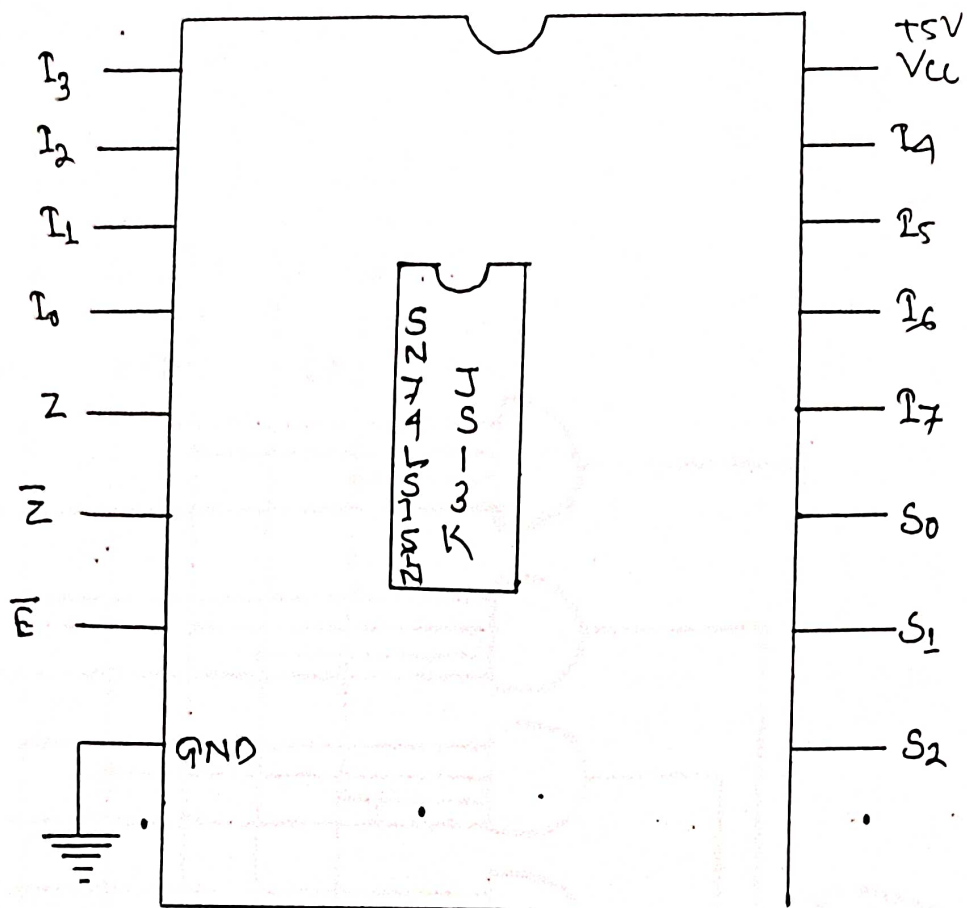
(8X1 MULTIPLEXER)

TRUTH TABLE :--

E	S_2	S_1	S_0	Q
1	0	0	0	I_0
1	0	0	1	I_1
1	0	1	0	I_2
1	0	1	1	I_3
1	1	0	0	I_4
1	1	0	1	I_5
1	1	1	0	I_6
1	1	1	1	I_7

(CKT DIAGRAM FOR 8×1 MULTIPLEXER)

(1 X 8 DEMULTIPLEXIER).

TRUTH TABLE:-

Inputs			Outputs							
S_2	S_1	S_0	Q_0	Q_1	Q_2	Q_3	Q_4	Q_5	Q_6	Q_7
0	0	0	L	0	0	0	0	0	0	0
0	0	1	0	1	0	0	0	0	0	0
0	L	0	0	0	L	0	0	0	0	0
D	L	L	0	0	0	L	0	0	0	0
L	0	0	0	0	0	0	1	0	0	0
L	0	L	0	0	0	0	0	1	0	0
1	1	0	0	0	0	0	0	0	1	0
1	1	1	0	0	0	0	0	0	0	1
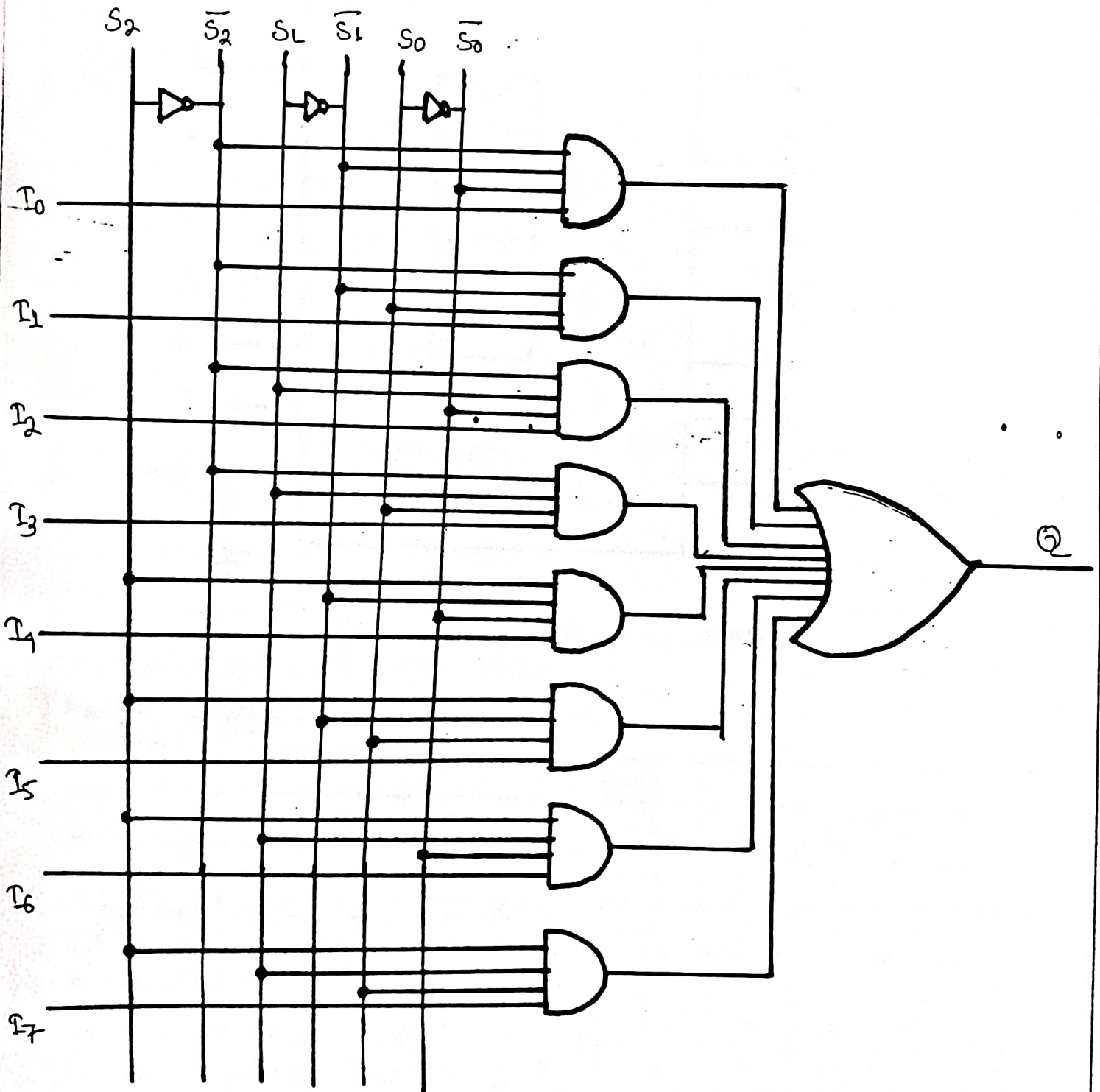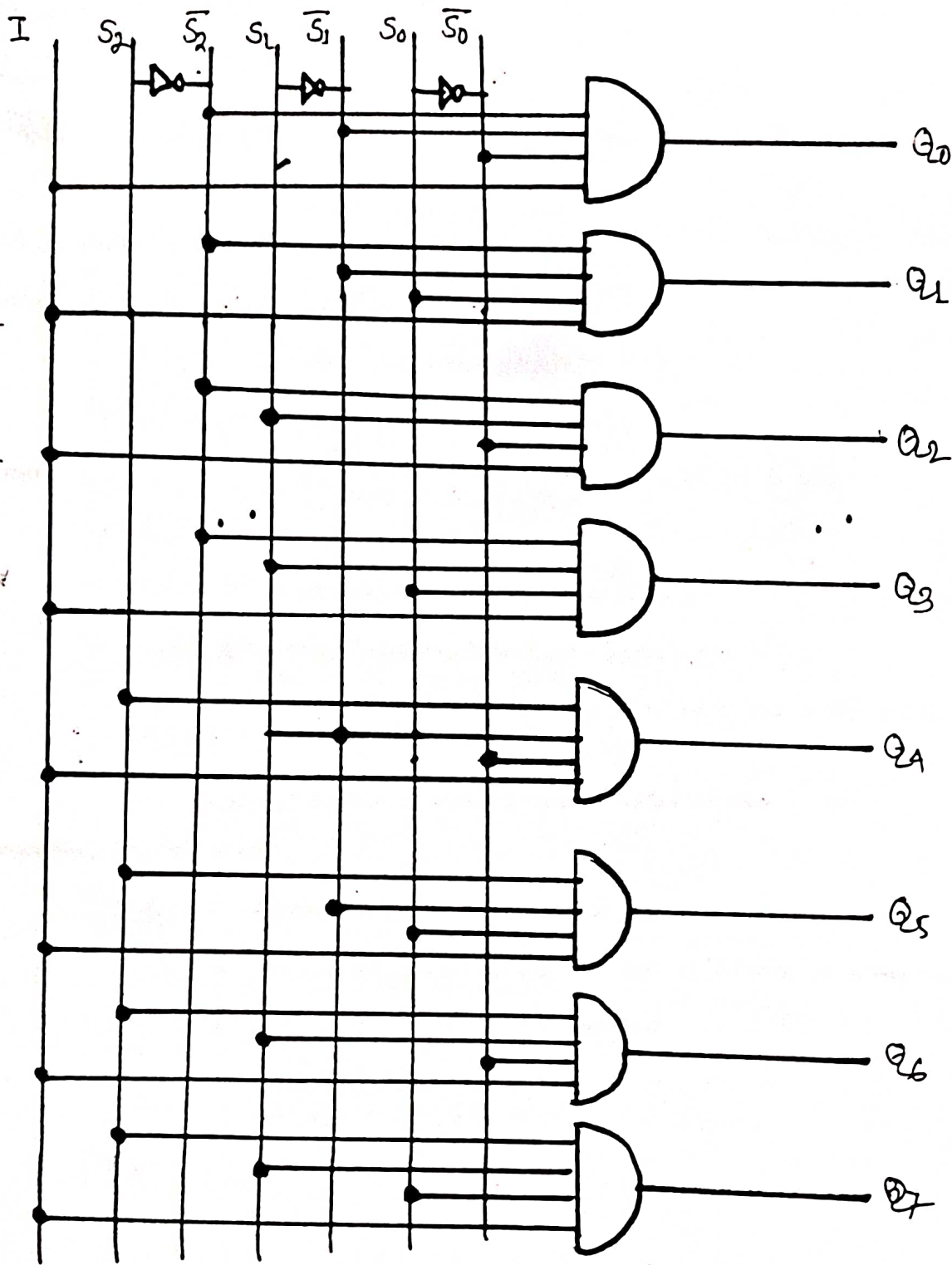
(CKT DIAGRAM FOR 1X8 DEMULTIPLEXER)

LABORATORY WORK INSTRUCTION		DEPARTMENT: ELECTRONICS AND TELECOMMUNICATION ENGG.
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Semester: 4th	Branch : Electrical.	Name of the Practical with Code : Digital Electronics Lab(PR-2)

Name of the Experiment: Study of Flip-Flop (S – R flip flop)

EQUIPMENT/TOOLS/ACCESSORIES REQUIRED :

- Basic Logic Trainer Kit-AET-21
- Connecting Wires.

PROCEDURE :

- Draw the truth Table for S-R flip-flop.
- From the truth table design the S-R flip flop circuit using NAND & NOR Gate separately.
- According to the logic diagram connect the logic trainer kit (AET-21)
- Operate the input switch in different states i.e. (00,01,10,11) and check the output by the help of indicator LED .
- Confirm about the output by checking the result with truth table.

SAFETY AND PRECAUTIONS , IF ANY :

- Do not connect the IC to any power supply directly.
- After connections of all connectors then only switch on the power supply.
- Don't disconnect the IC during operation.
- Handle it carefully.

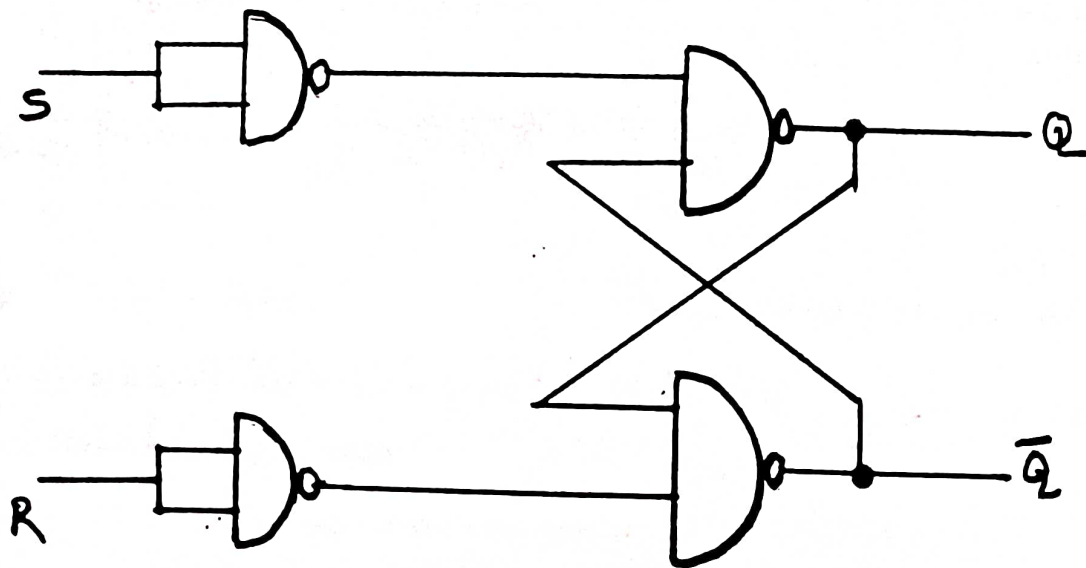(BLOCK DIAGRAM OF S-R FLIP-FLOP).
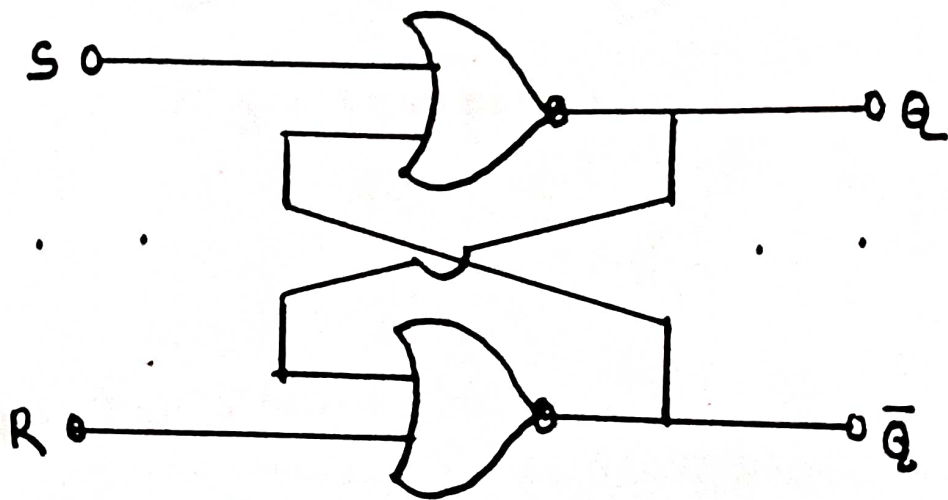
(CKT DIAGRAM OF S-R FLIP FLOP USING NOR).

Inputs		Outputs	
S	R	Q	$\bar{Q}$
0	0	HOLD	
0	L	0	L
1	0	L	0
1	L	INVALID.	

(TRUTH TABLE OF S-R FLIP FLOP)

(S-R FLIP FLOP USING NAND).

TRUTH TABLE:--

INPUTS				OUTPUTS	
S	R	$\bar{S}$	$\bar{R}$	Q	$\bar{Q}$
0	0	1	1	Q	$\bar{Q}$
0	1	1	0	0	1
1	0	0	1	1	0
1	0	0	1	INVALID	

LABORATORY WORK INSTRUCTION	DEPARTMENT: ELECTRONICS AND TELECOMMUNICATION ENGG.
Date of Preparation: 20-12-2010	Prepared by : Jelly Das, Verified by :	Counter Signature of the HOD :
Semester 4th	Branch : Electrical.	Name of the Practical with Code : Digital Electronics Lab(PR-2)

Name of the Experiment: Study of Flip-Flops (J-K flip-flop,D flip-flop,T flip-flop)

**EQUIPMENT/TOOLS/ACCESSORIES REQUIRED :**

- Basic Logic Trainer Kit-N-24
- Connecting Wires.

PROCEDURE :

- Draw the truth Table for J-K flip-flop,D flip-flop,T flip-flop.
- From the truth table design the logic diagrams .
- According to the logic diagram connect the trainer kit.
- Before giving the supply check the circuit again.
- Connect the inputs from push button switches A & B and clock input from the clock switch.
- Switch on the power supply.
- Give input 0 or 1 from logic switches by push on or off switches A or B.
- Confirm about the output by checking the result with truth table.

SAFETY AND PRECAUTIONS , IF ANY :

- Do not connect the IC to any power supply directly.
- After connections of all connectors then only switch on the power supply.
- Don't disconnect the IC during operation.
- Handle it carefully.
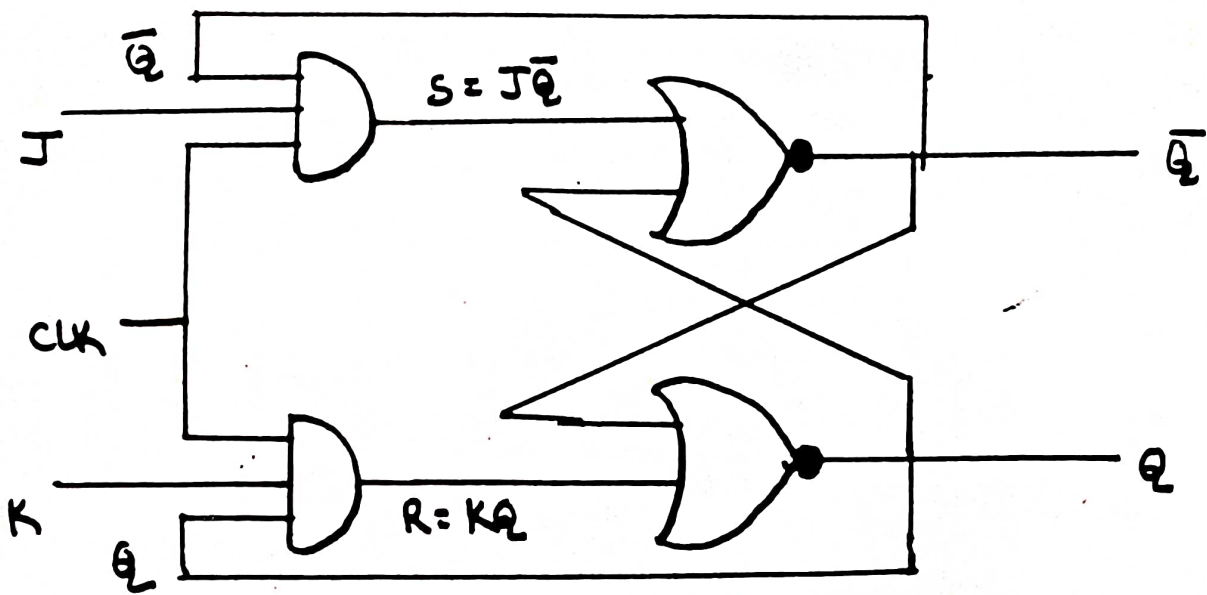
(CKT DIAGRM FOR J-K FLIP-FLOP)

TRUTH TABLE :-

previous	input		Next
Q_n	J	K	Q_{n+1}
0	0	0	0
0	0	1	0
0	1	0	1
0	1	1	1
1	0	0	1
1	0	1	0
1	1	0	1
1	1	1	0