

## Experiment 2-3 XOR Gate Circuit

### OBJECTIVE

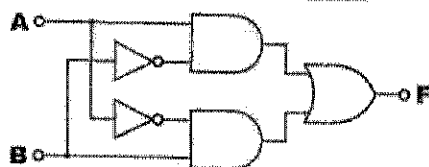
1. To understand the characteristics of XOR gate.
2. To construct an XOR gate with NAND gates or basic logic gates.

### DISCUSSION

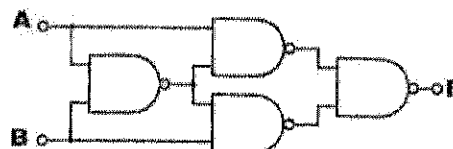
The symbol of an XOR gate is shown in Fig. 2-3-1. The output  $F$  is equal to  $A \oplus B = \overline{A}B + A\overline{B}$ . XOR gates can be constructed using NOT, OR, AND, NOR or NAND gates or by using four NAND gates, as shown in Fig. 2-3-2 (a) and (b).



Fig. 2-3-1 Symbol of XOR gate



(a) Constructed with basic gates



(b) Constructed with NAND gates

Fig. 2-3-2 XOR gate circuits

Since  $F = \overline{A}B + A\overline{B}$ , when  $B=0$ ,  $F = \overline{A} \cdot 0 + A \cdot \overline{0} = A \cdot 1 = A$  and the circuit act as buffer. When  $B=1$ ,  $F = \overline{A} \cdot 1 + A \cdot \overline{1} = \overline{A} \cdot 1 = \overline{A}$ , the circuit act as an inverter. In other words, the input state of an XOR gate determines whether it will act as a buffer or an inverter. In this experiment, we will use basic logic gates to construct XOR gates and study the relationship between the inputs and outputs.

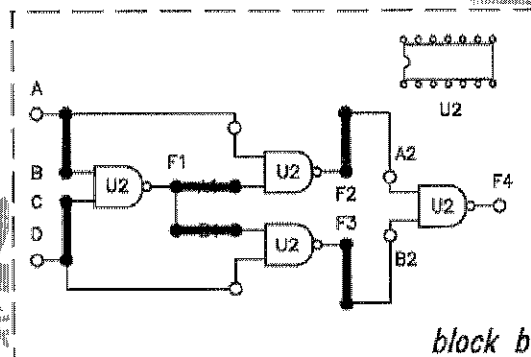
## EQUIPMENT REQUIRED

1. KL-22001 Basic Electrical/Electronic Circuit Lab
2. KL-26001 Combinational Logic Circuit Experiment Module (1)

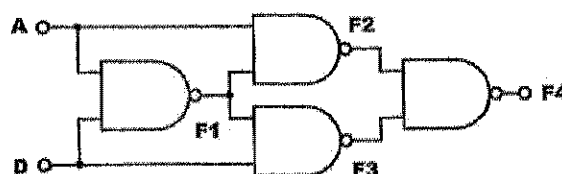
## PROCEDURE

### A. Constructing XOR Gate with NAND Gates

1. Set the KL-26001 Module on the KL-22001 Basic Electrical/Electronic Circuit Lab, and locate block b. Complete the connections by referring to the wiring diagram in Fig. 2-3-3(a) and the circuit in Fig. 2-3-3(b). Connect inputs A to SW1, D to SW2; outputs F1 to L1, F2 to L2; F3 to L3 and F4 to L4. Apply +5VDC from the Fixed Power to KL-26001 Module.



(a) Wiring diagram (KL-26001 block b)



(b) Equivalent circuit

Fig.2-3-3 XOR gate constructed with NAND gates

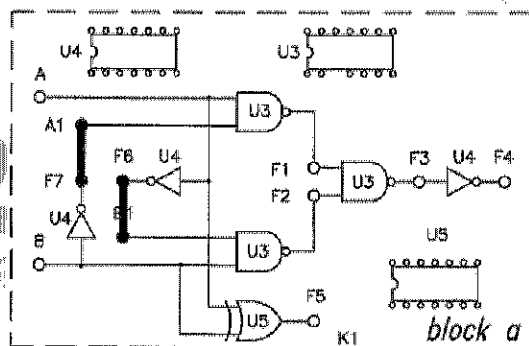
2. Follow the input sequences for A and D in Table 2-3-1 and record the outputs.

INPUTS		OUTPUTS			
SW2(D)	SW1(A)	F1	F2	F3	F4
0	0				
0	1				
1	0				
1	1				

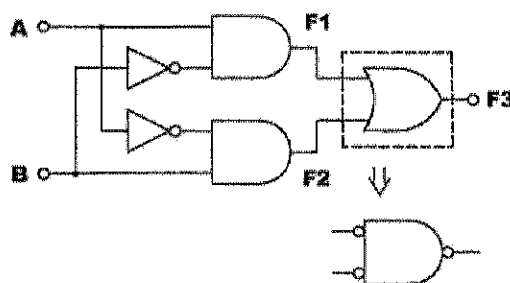
Table 2-3-1

## B. Constructing XOR Gate with Basic Gates

1. Set the KL-26001 Module on the KL-22001 Basic Electrical/Electronic Circuit Lab, and locate block a. Complete the connections by referring to the wiring diagram in Fig. 2-3-4(a) and the circuit in Fig. 2-3-4(b). Apply +5VDC from the Fixed Power on KL-22001 Lab to KL-26001 Module.
2. Connect inputs A, B to SW1, SW2; outputs F1, F2, F3 to L1, L2, L3.



(a) Wiring diagram (KL-26001 block a)



(b) Equivalent circuit

Fig.2-3-4 XOR gate constructed with basic gates

3. Follow the input sequences for A and B in Table 2-3-2 and record the outputs.

INPUTS		OUTPUTS		
SW2(B)	SW1(A)	F1	F2	F3
0	0			
0	1			
1	0			
1	1			

Table 2-3-2