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Implementation and verification of decoder/de-multiplexer and encoder using logic gates.

➤ AIM:-

To analyse the truth table of 4 * 2 decoder/de-multiplexer using NOT (7404) and AND (7408) logic gate ICs and 2 * 4 encoder using OR (7432) logic gate IC and to understand the working of 4 * 2 decoder and 2 * 4 encoder circuit with the help of LEDs display.

➤ THEORY:-

• **Introduction**

Binary code of N digits can be used to store 2^N distinct elements of coded information. This is what encoders and decoders are used for. Encoders convert 2^N lines of input into a code of N bits and Decoders decode the N bits into 2^N lines.

1) 2x4 Decoder / De-multiplexer

The name "Decoder" means to translate or decode coded information from one format into another, so a digital decoder transforms a set of digital input signals into an equivalent decimal code at its output

A decoder is a combinational circuit that converts binary information from n input lines to a maximum of m=2^n unique output lines.

Figure 1. Logic Diagram of Decoder

1.1) 2-to-4 Binary Decoder

$$Q_0 = \bar{A}\bar{B}$$

$$Q_1 = \bar{A}B$$
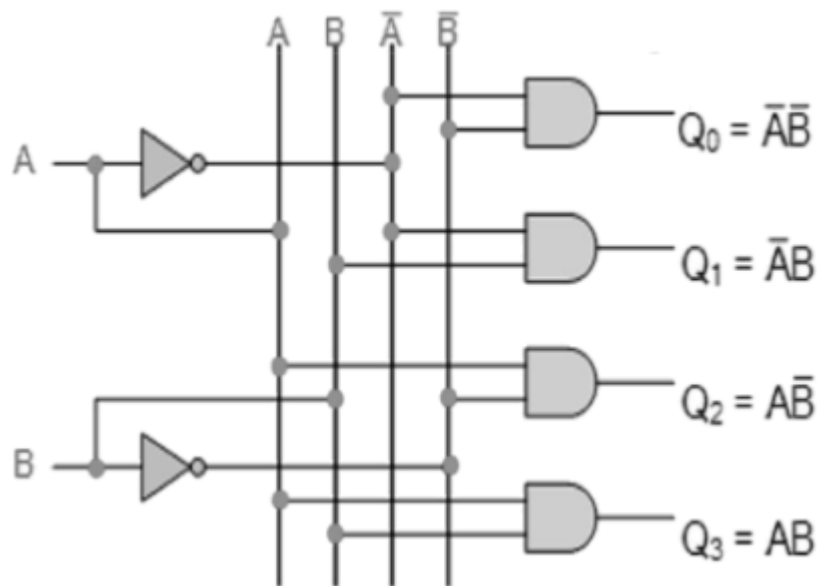
$$Q_2 = A\bar{B}$$

$$Q_3 = AB$$

Figure 2. Circuit Diagram of 2-to-4 Decoder

The 2-to-4 line binary decoder depicted above consists of an array of four AND gates. The 2 binary inputs labelled A and B are decoded into one of 4 outputs, hence the description of 2-to-4 binary decoder. Each output represents one of the minterms of the 2 input variables, (each
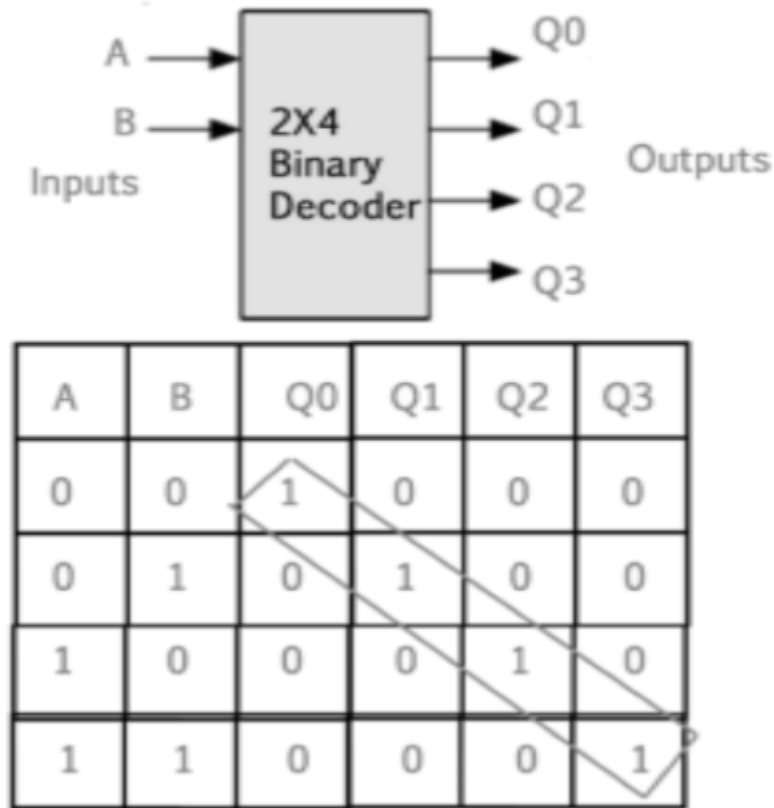
output = a minterm).

A	B	Q0	Q1	Q2	Q3
0	0	1	0	0	0
0	1	0	1	0	0
1	0	0	0	1	0
1	1	0	0	0	1

Figure 3. Logic Diagram and Truth table of 2-to-4 Decoder

The binary inputs A and B determine which output line from Q0 to Q3 is "HIGH" at logic level "1" while the remaining outputs are held "LOW" at logic "0" so only one output can be active (HIGH) at any one time.

Therefore, whichever output line is "HIGH" identifies the binary code present at the input, in other words it "decodes" the binary input.Some binary decoders have an additional input pin labelled "Enable" that controls the outputs from the device.

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This extra input allows the decoders outputs to be turned "ON" or "OFF" as required. Output is only generated when the Enable input has value 1; otherwise, all outputs are 0. Only a small change in the implementation is required: the Enable input is fed into the AND gates which produce the outputs.

If Enable is 0, all AND gates are supplied with one of the inputs as 0 and hence no output is produced. When Enable is 1, the AND gates get one of the inputs as 1, and now the output depends upon the remaining inputs. Hence the output of the decoder is dependent on whether the Enable is high or low.

➢ PRETEST:-

BCD to seven segment conversion is a _____

◉ a: Decoding process ○ b: Encoding process ○ c: Comparing process ○ d: None of the mentioned

Invalid BCD can be made to valid BCD by adding with _____

○ a: 0101 ◉ b: 0110 ○ c: 0111 ○ d: 1001

Device which converts an input device state into a binary representation of ones or zeros is termed as

◉ a: encoder ○ b: decoder ○ c: multiplexer ○ d: data selecter

A circuit that changes a code into a set of signals is called

○ a: encoder ◉ b: decoder ○ c: multiplexer ○ d: data selecter

Modulo 6 counter can be built using a three-element

◉ a: shift register ○ b: bus ○ c: flip flop ○ d: trigger

➢ PROCEDURE:-

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1)2X4 DECODER / De-multiplexer

Step-1) Connect the supply(+5V) to the circuit.
Step-2) First press "ADD" button to add basic state of your output in the given table.
Step-3) Press the switches to select the required inputs named "A" and "B". Also check their corresponding outputs named "Q_0" and "Q_1" and "Q_2" and "Q_3".
Step-4) Press "ADD" button to add your inputs and outputs in the given table.
Step-5) Repeat step 3 & step 4 for next state of inputs and their corresponding outputs.
Step-6) Press the "PRINT" button after completing your simulation to get your results.

2)4X2 ENCODER

Step-1) Connect the supply(+5V) to the circuit.
Step-2) First press "ADD" button to add basic state of your output in the given table.
Step-3) Press the switches to select the required inputs "D_0" and "D_1" and "D_2" and "D_3". Also check their corresponding ouyputs named "Q_1" and "Q_0".
Step-4) Press "ADD" button to add your inputs and outputs in the given table.
Step-5) Repeat step 3 & step 4 for next state of inputs and their corresponding outputs.
Step-6) Press the "PRINT" button after completing your simulation to get your results.

➢ **POSTTEST:-**

A decoder converts n inputs to _____outputs

○ a: n^n ○ b: n ○ c: n^2 ○ d: 2^n

BCD to 7 segment convertion in a _____

a: Comparing process   b: None of the answers   c: Encoding process   d: Decoding process

Decoders and Encoders are doing reverse operation.

a: True   b: False   c: may be   d: may not be

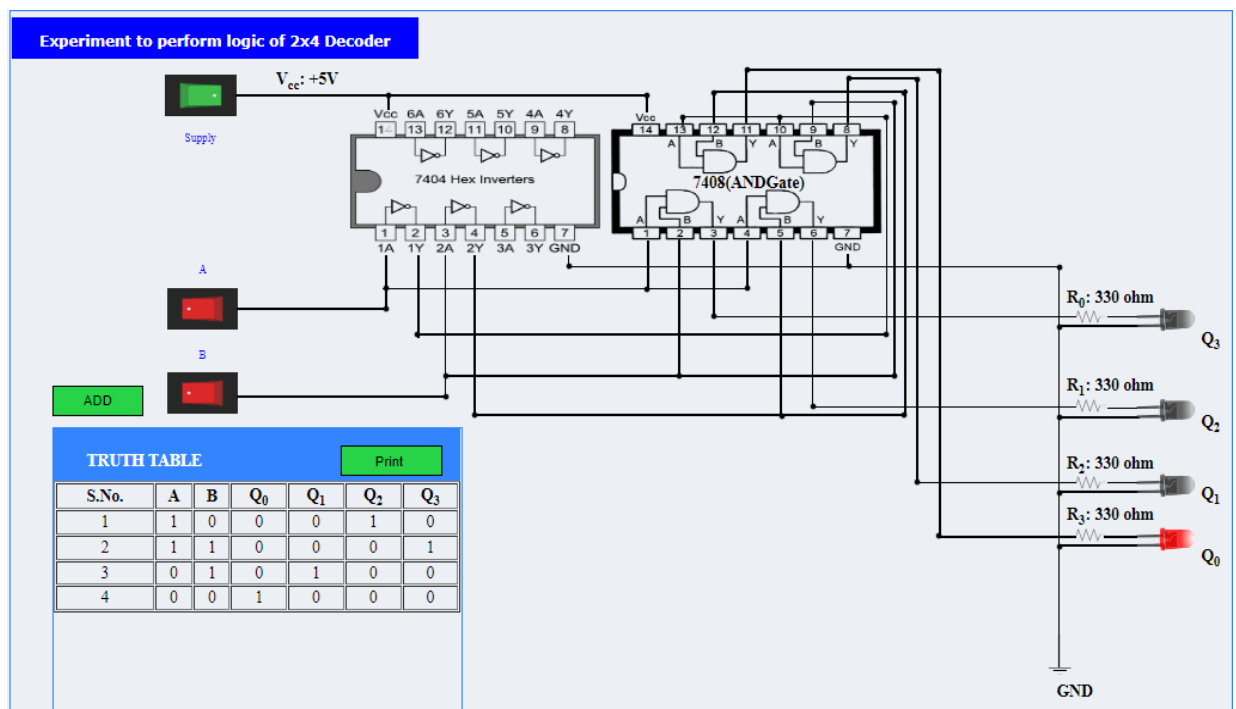**Which of the following are building block of the Encoders?**

a: OR Gate   b: AND Gate   c: NOT Gate   d: NAND Gate

Which of the following is the Decoder IC?

a: 7890   b: 8870   c: 4047   d: 4041

➢ **SIMULATION:-**

● **DECODER:-**

Experiment to perform logic of 2x4 Decoder

S.No.	A	B	Q₀	Q₁	Q₂	Q₃
1	1	0	0	0	1	0
2	1	1	0	0	0	1
3	0	1	0	1	0	0
4	0	0	1	0	0	0

TRUTH TABLE

S.No.	A	B	Q_0	Q_1	Q_2	Q_3
1	1	0	0	0	1	0
2	1	1	0	0	0	1
3	0	1	0	1	0	0

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4	0	0	1	0	0	0

CONCLUSION:-

A decoder is a device that generates the original signal as output from the coded input signal and converts n lines of input into 2n lines of output. An AND gate can be used as the basic decoding element because it produces a high output only when all inputs are high