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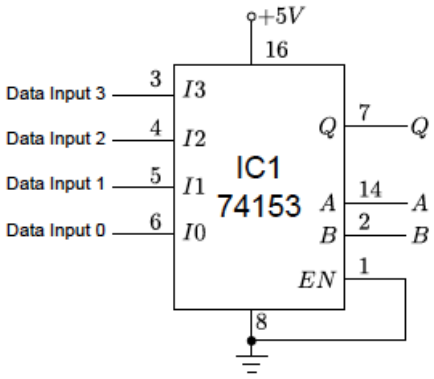
# Laboratory 9

## *Multiplexer and Demultiplexer*

**1. Multiplexer:**

1.1 Connect a logic circuit as shown in the following figure. Data input, pin A and B shall be connected to the logic switches and pin Q to a logic monitor.




1.2 Supply the data input for pin DATA INPUT 0 to 3 as specified in the following table.

1.3 Supply the signal for pin A and B as specified in the following table. Observe and record the output Q and the corresponding match to data input channel.

| Data Input | | | | Control Input | | Output | Match to |
|---|---|---|---|---|---|---|---|
| $I_0$ | $I_1$ | $I_2$ | $I_3$ | B | A | (Q) | Data Input |
| 1 | 0 | 1 | 0 | 0 | 0 | 1 | $I_0$ |
| 1 | 0 | 1 | 0 | 0 | 1 | 0 | $I_1$ |
| 1 | 0 | 1 | 0 | 1 | 0 | 1 | $I_2$ |
| 1 | 0 | 1 | 0 | 1 | 1 | 0 | $I_3$ |
| 0 | 1 | 0 | 1 | 0 | 0 | 0 | $I_0$ |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 | $I_1$ |
| 0 | 1 | 0 | 1 | 1 | 0 | 0 | $I_2$ |
| 0 | 1 | 0 | 1 | 1 | 1 | 1 | $I_3$ |

**Remark**: EN=0

$\bar{A}\bar{B}I_0$

$\bar{A}BI_1$

$A\bar{B}I_2$

$ABI_3$

Instructor's signature

Sugar

1.4 Connect pin EN to +5V and redo the experiment 1.2-1.3. Record the results in the following table.

| Data Input | | | | Control Input | | Output | Match to |
|---|---|---|---|---|---|---|---|
| $I_0$ | $I_1$ | $I_2$ | $I_3$ | B | A | (Q) | Data Input |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | - |
| 1 | 0 | 1 | 0 | 0 | 1 | 0 | - |
| 1 | 0 | 1 | 0 | 1 | 0 | 0 | - |
| 1 | 0 | 1 | 0 | 1 | 1 | 0 | - |
| 0 | 1 | 0 | 1 | 0 | 0 | 0 | - |
| 0 | 1 | 0 | 1 | 0 | 1 | 0 | - |
| 0 | 1 | 0 | 1 | 1 | 0 | 0 | - |
| 0 | 1 | 0 | 1 | 1 | 1 | 0 | - |

**Remark**: EN=1

1.5 Draw conclusions from the preceding experiment

If A=0, B=0, Q = $I_0$
If A=0, B=1, Q = $I_1$
If A=1, B=0, Q = $I_2$
If A=1, B=1, Q = $I_3$

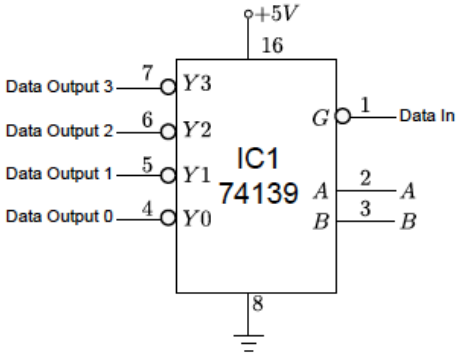
When EN is connected to GND

But all will be 0 if EN connect to 1 CSV. #

Instructor's signature

**2. Demultiplexer:**

2.1 Connect the circuit as shown in the following figure.




2.2 Connect the output pin DATA OUTPUT 0 to 3 to the logic monitor.

2.3 Supply the control signal for pin A, B, and the Data in to pin G according to the following table.

2.4 Observe and record the results.

| Input | | | Output | | | |
|---|---|---|---|---|---|---|
| Data In | B | A | Out3 | Out2 | Out1 | Out0 |
| 1 | 0 | 0 | 1 | 1 | 1 | 1 |
| 0 | 0 | 1 | 1 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 0 | 1 | 1 |
| 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 1 | 1 | 0 | 1 | 1 | 1 | 1 |
| 0 | 1 | 1 | 0 | 1 | 1 | 1 |

2.5 Draw conclusions form the preceding experiments.

If Data in = 1 → $Out_0$, $Out_1$, $Out_2$, $Out_3$ will all be 1

IF Data in = 0 → Suppose AB is a binary number,
the Out which coresponed to the
binary number will be 0.

Example Data in = 0 $Out_3$ $Out_2$ $Out_1$ $Out_0$
A = 0 1 1 0 1
B = 1

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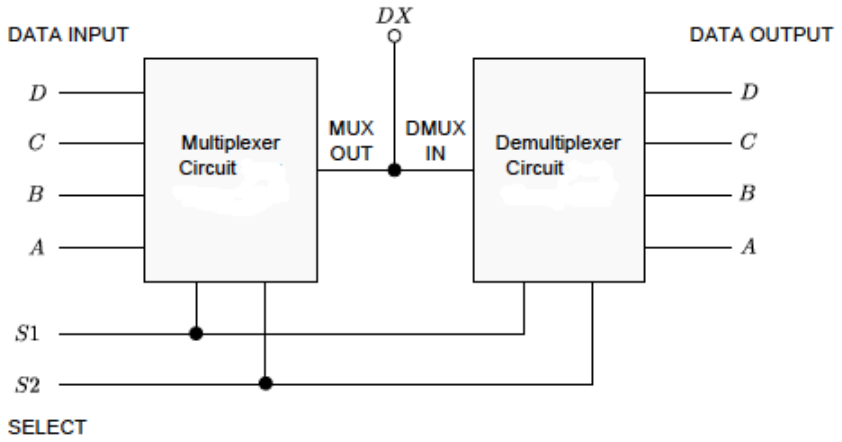
**3. Multiplexer-Demultiplexer:**

3.1 Connect the circuit as shown in the following figure




3.2 Supply the data to DATA IN 0 to 3 as specified in the following table.

3.3 Connect DATA OUTPUT 0 to 3 to the logic monitor where DATA OUTPUT 3 is MSB.

3.4 Connect pin A and B of IC1 and IC2 (represented by $S_2$ and $S_1$ respectively) to logic switches.

3.5 Supply the value to pin A and B as specified. Observe the result at pin DATA OUTPUT 0 to 3 and compared them to the data at DATA IN pin.

3.6 Observe and record the results in the following table

| Data Input | | | | Control Input | | DX | Data output | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| D | C | B | A | $S_1$ | $S_2$ | | D | C | B | A |
| 1 | 0 | 1 | 0 | 0 | 0 | 0 | 1 | 1 | 1 | 0 |
| 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 | 1 |
| 1 | 0 | 1 | 0 | 1 | 0 | 0 | 1 | 0 | 1 | 1 |
| 1 | 0 | 1 | 0 | 1 | 1 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 0 | 0 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 0 | 1 | 0 | 1 | 1 | 0 | 1 |
| 0 | 1 | 0 | 1 | 1 | 0 | 1 | 1 | 1 | 1 | 1 |
| 0 | 1 | 0 | 1 | 1 | 1 | 0 | 0 | 1 | 1 | 1 |

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**4. Assignments**

4.1 A control room in a factory needs to monitor the status of four working machines. If the machine cannot function properly, an alarm signal of logic 0 will be sent to the control room. An operator comes and checks the alarm of the machines periodically (via control inputs). If there is alarm, the source of this alarm will be displayed and the operator can then take action. Construct a circuit using a multiplexer, a demultiplexer (encoder) and necessary gates, which gives outputs of alarm as states in the following conditions.

a) Alarm signal of each machine is connected to a multiplexer. ($I_3$ to machine no.1, $I_2$ to machine no.2 , $I_1$ to machine no.3 and $I_0$ to machine no.4.)

b) Output signals are connected to a demultiplexer (encoder)

| Source of Alarm | Output | | | |
|---|---|---|---|---|
| | Output3 | Output2 | Output1 | Output0 |
| Machine no. 1 | 0 | 0 | 0 | 1 |
| Machine no. 2 | 0 | 0 | 1 | 0 |
| Machine no. 3 | 0 | 1 | 0 | 0 |
| Machine no. 4 | 1 | 0 | 0 | 0 |

c) Only two control inputs are available for the system

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4.2 Construct a circuit, which can compare two 4-bit binary numbers bit by bit using a multiplexer IC 74153. If both the inputs are the same, the output LED should be ON otherwise it should be OFF.

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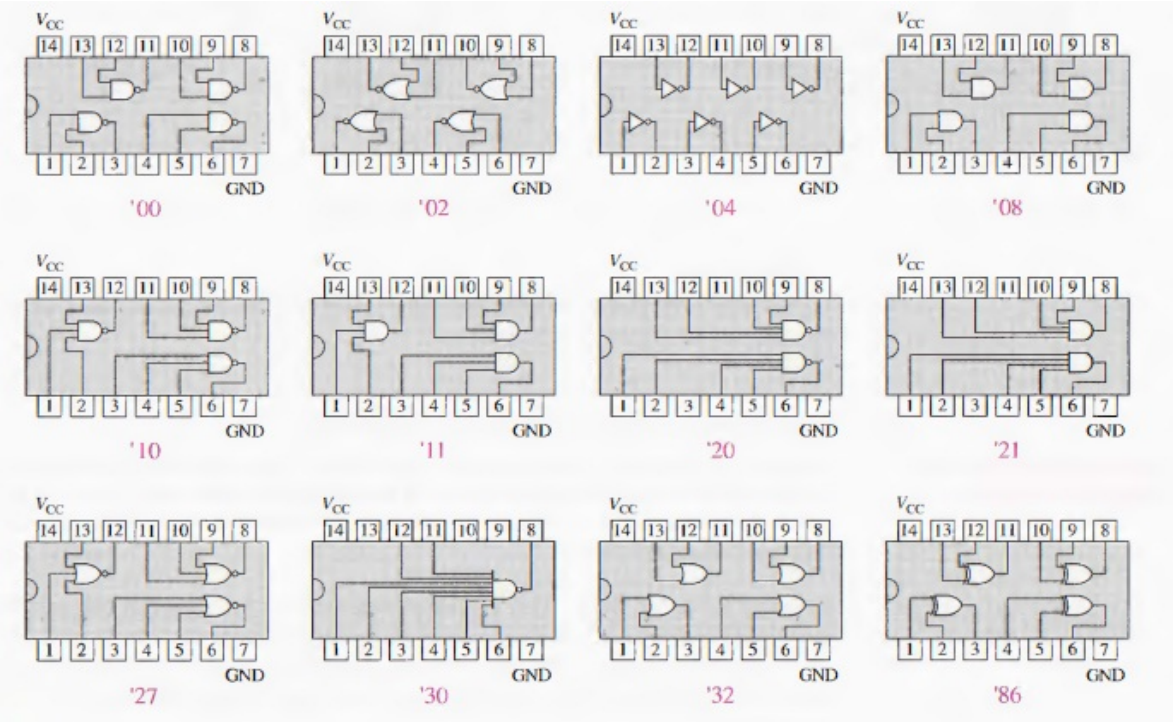
4.3 Realize the following function using IC 74138, a 3-to-8 line demultiplexer (decoder), and necessary gates

$F_1(a,,b,c) = m_0 + m_5 + m_7$

$F_2(a,b,c) = m_0 + m_1 + m_3$

Instructor's signature

**Logic Diagram of frequently used gates**



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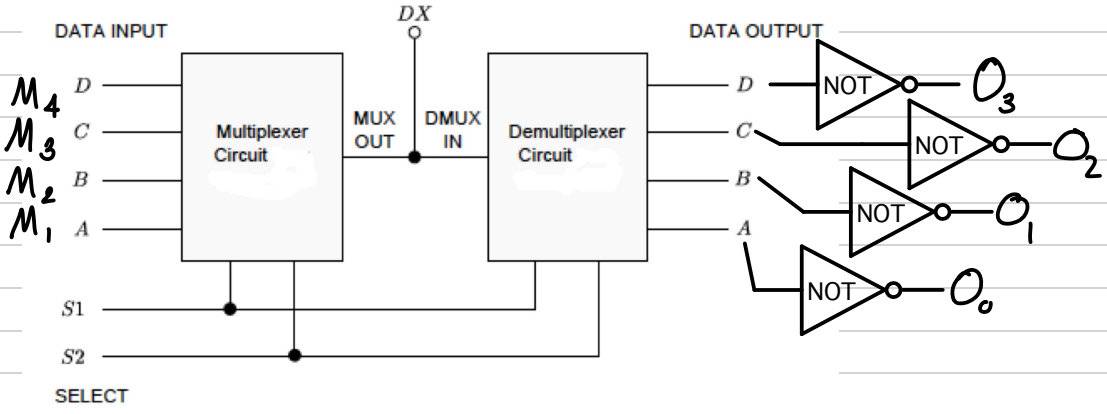
b) Output signals are connected to a demultiplexer (encoder)

P — 0 : Not working properly
P — 1 : Working properly

| Source of Alarm | Output | | | |
|---|---|---|---|---|
| | Output3 | Output2 | Output1 | Output0 |
| Machine no. 1 | 0 | 0 | 0 | 1 |
| Machine no. 2 | 0 | 0 | 1 | 0 |
| Machine no. 3 | 0 | 1 | 0 | 0 |
| Machine no. 4 | 1 | 0 | 0 | 0 |

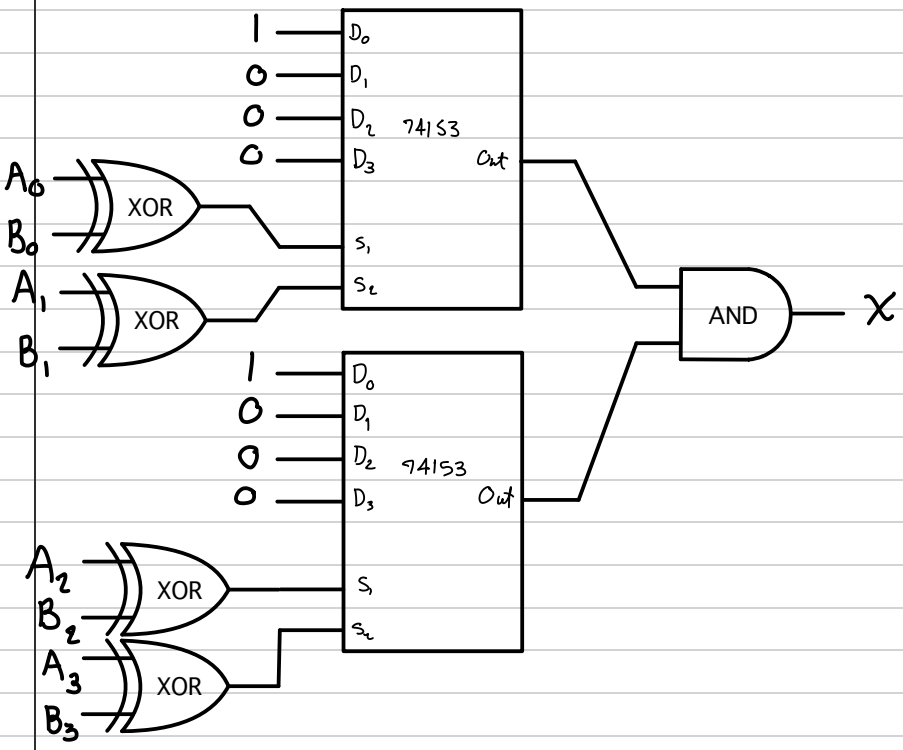
c) Only two control inputs are available for the system



4.2 Construct a circuit, which can compare two 4-bit binary numbers bit by bit using a multiplexer IC 74153. If both the inputs are the same, the output LED should be ON otherwise it should be OFF.

Number $A = A_3A_2A_1A_0$

Number $B = B_3B_2B_1B_0$



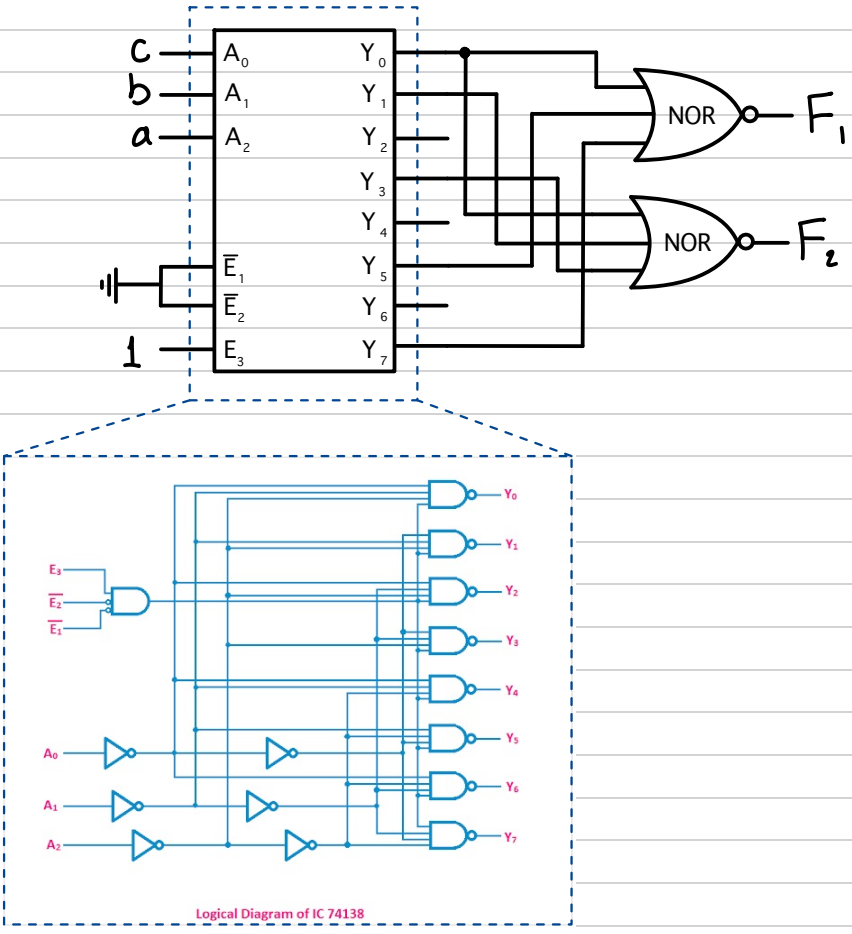
4.3 Realize the following function using IC 74138, a 3-to-8 line demultiplexer (decoder), and necessary gates

$F_1(a,,b,c) = m_0 + m_5 + m_7$

$F_2(a,b,c) = m_0 + m_1 + m_3$

$F_1(a,b,c) = m_0 + m_5 + m_7 = \bar{a}\bar{b}\bar{c} + a\bar{b}c + abc$

$F_2(a,b,c) = m_0 + m_1 + m_3 = \bar{a}\bar{b}\bar{c} + \bar{a}\bar{b}c + \bar{a}bc$




Logical Diagram of IC 74138