Victoria University of Bangladesh
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Final Submission

①

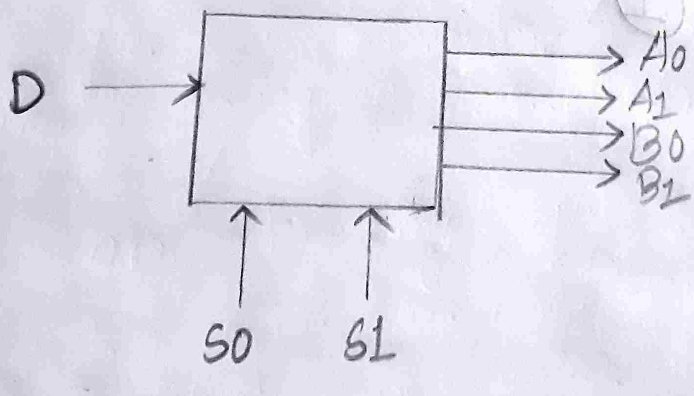
Ans to the Q no - 1(a)

*) Demux is a one-to-many circuit, which is exactly the opposite to the multiplexer. With the use of a Demultiplexer, data from one input can be passed to one of the many output data lines.

*) 1 data input (D).
*) 2 select lines (S1 and S0)
*) 4 outputs (A0, A1, B0, B1)

Logic diagram:-

Input line



Truth table:
For a 2 to 4 demultiplexer, the select lines S1 and S0 determine which output line (A0, A1, B0, B1) the output (D) will be routed to

S1	S0	A0	A1	B0	B2
0	0	D/1	0	0	0
0	1	0	D/1	0	0
1	0	0	0	D/1	0
1	1	0	0	0	D/1

Explanation:-

(*) When S1=0 and S0=0, the input D is routed to Y0.

(*) When S1=0 and S0=1, the input D is routed to Y1,

(*) When S1=1 and S0=0, the input D is routed to Y2.

(*) When S1=1 and S0=1, the input D is routed to Y3.

In each ~~care~~ case, only one ~~input~~ output is active (carrying the value of DDD), while the others are inactive (set to 0).

Ans to the Q no-1(b)

An encoder is a combinational circuit that converts one of its 2^n inputs to a binary code of n bits.

Octal to Binary encoder:- An octal to binary encoder has 8 inputs and 3 outputs.

Truth table:-

Octal Input	Binary Input
000	000
001	001
010	010
011	011
100	100
101	101
110	110
111	111

Limitations of Octal to Binary Encoder:-

1. Single Input Activation:- Only one input should be active at any given time, which may not always be practical.

2. Priority Encoding Required:- In practical applications, if more than one input is active, a priority encoder is needed to determine which input to encode.

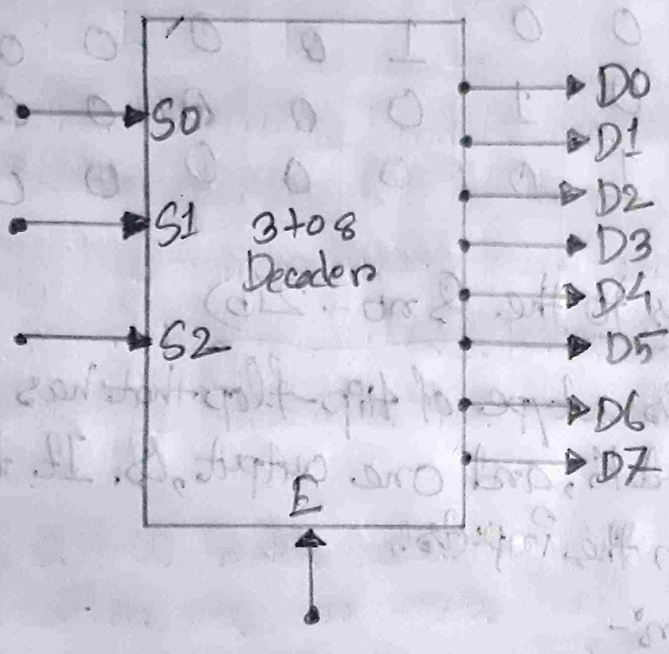
3. Complexity Increases with Input:- As the number of inputs increases, the complexity of the encoder also increases.

Ans to the Q no 2(a)

A decoder is a combinational circuit that converts n binary inputs to 2^n unique outputs.

3-to-8 line decoder: A 3-to-8 line decoder takes 3 input lines and decodes them into one of 8 outputs.

Logic Diagram:-



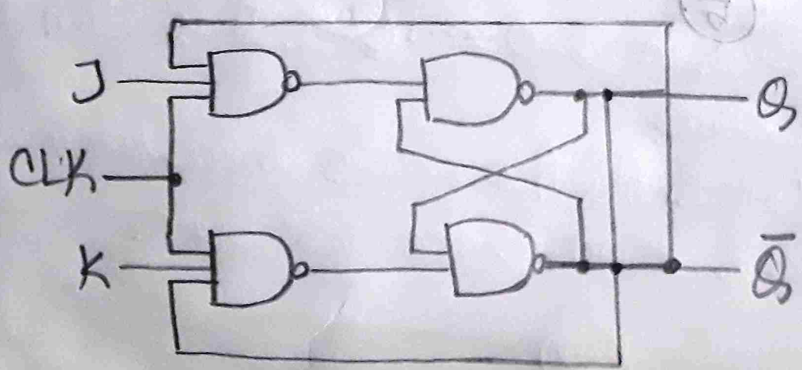
Truth table:

Inputs				Outputs							
S0	S1	S2	E	D0	D1	D2	D3	D4	D5	D6	D7
x	x	x	0	0	0	0	0	0	0	0	0
0	0	0	1	0	0	0	0	0	0	0	1
0	0	1	1	0	0	0	0	0	0	1	0
0	1	0	1	0	0	0	0	0	1	0	0
0	1	1	1	0	0	0	0	1	0	0	0
1	0	0	1	0	0	0	1	0	0	0	0
1	0	1	1	0	0	1	0	0	0	0	0
1	1	0	1	0	1	0	0	0	0	0	0
1	1	1	1	1	0	0	0	0	0	0	0

Ans to the Q no - 2(b)

A JK flip-flop is a type of flip-flop that has two inputs, labeled J and K, and one output, Q. It toggles its output based on the inputs.

Logic Diagram:-



Truth Table

J	K	Q_n	Q_{n+1}
0	0	0	0
0	0	1	1
0	1	0	0
0	1	1	0
1	0	0	1
1	0	1	1
1	1	0	1
1	1	1	0

In the diagram, J and K are inputs, Q is the output, and Q' is the complement of the output.

JK flip flop compromaises four possible combinations of inputs; J=0, K=0; J=0, K=1; J=1, K=0; and J=1, K=1. These input combinations determine the behaviour of flip flop and its output.

- J=0, K=0: In this state, flip flop retains its preceding state. It neither sets nor resets itself, making it stable.
- J=0, K=1: This input combination forces forces flip flop to reset, resulting in Q=0 and $\bar{Q}$=1. It is often referred to as the "reset" state.
- J=1, K=0: Here, flip flop resides in the set mode, causing Q=1 and $\bar{Q}$=0. It is known as the "set" state.

(4) J=K, K=1: This combination toggles flip flop. If the previous state is Q=0, it switches to Q=1 and vice versa. This makes it valuable for frequency division and data storage applications.

Characteristic Equation of JK flip flop

The characteristic equation of JK flip flop represents the relationship between the current state ($Q(t)$), the inputs (J and K), and the next state ($Q(t+1)$). Here is the characteristic of JK flip flop.

$$Q(t+1) = J\bar{Q}(t) + Q\bar{K}(t)$$

In this equation, the term $J\bar{Q}(t)$ representation the effect of the J input when it is in the set formation ($J=1$), and $\bar{K}(t)$ represents the effect of the K input when it is reset ($K=0$). The term $Q\bar{K}(t)$ respresents the effect of the K input when it is in the set form ($K=1$), and $\bar{Q}(t)$ represents the complement of the current state.

Ans to the Q no - 3(a)

Find the complement of the functions $F1 = x'y'z' + x'y'z'$ and $F2 = x(y'z' + y'z')$ by applying De Morgan's theorem.

Complement of F1:

$F1 = x'y'z' + x'y'z'$

Applying De Morgan's theorem:

$F1' = (x'y'z' + x'y'z')'$

$= (x'y'z')' . (x'y'z')'$

$= (x+y+z) . (x+y+z')$

Complement of F2:

$F2 = x(y'z' + y'z')$

$= x(y'z')$

Applying De Morgan's theorem:

$F2' = (x.(y'z'))'$

$= x' + (y'z')'$

$= x' + (y+z)$

Ans to the Q no 3(b)

Decimal to Binary Conversion:

Decimal 41 in binary is 101001101 001101001.

Integer Quotient, Remainder, and Coefficient:

(i) Devided 41 by 2:

- 41/2 = 20 quotient, remainder 1
- 20/2 = 10 quotient, remainder 0
- 10/2 = 5 quotient, remainder 0
- 5/2 = 2 quotient, remainder 1
- 2/2 = 1 quotient, remainder 0
- 1/2 = 0 quotient, remainder 1

So, the binary form of 41 is read from bottom to top, which is 101001101001101001.