

**National University**



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Emerging Sciences



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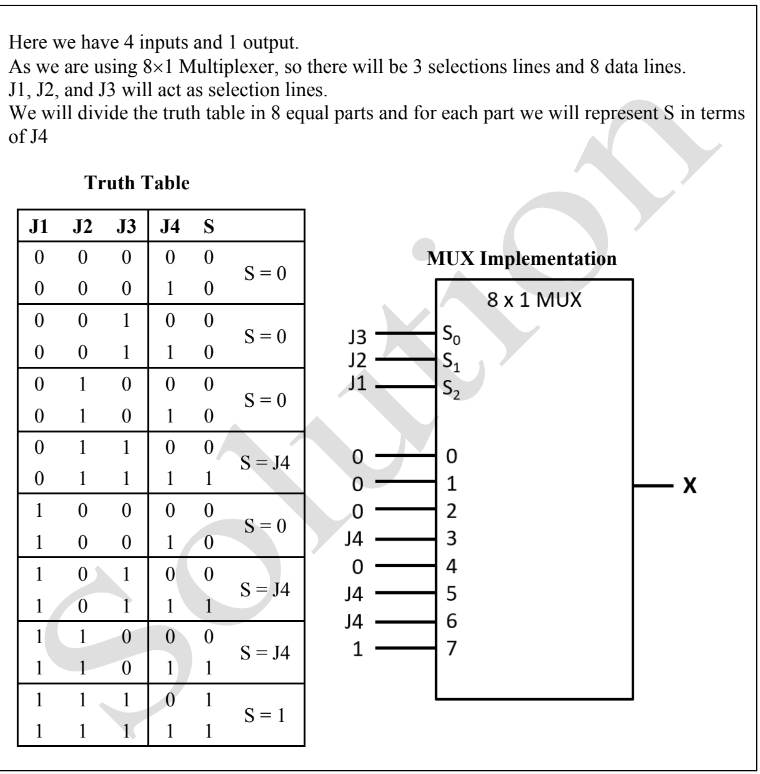
**EE1005 – Digital Logic Design**

**Quiz# 5** – SOLUTION MANUAL

**Question 1:** Create a digital game design titled "Pakistan Voice Idol Game". This simulation involves a competition setting with four judges. Each judge has the ability to vote for a contestant. A vote is represented as HIGH (indicating approval), while the absence of a vote is represented as LOW. Your task is to design a system using an 8x1 Multiplexer and basic logic gates where a contestant is deemed a winner and triggers a "winning light" to turn ON only when they receive the maximum possible votes from the judges. If the contestant does not receive the maximum votes, the winning light should remain OFF, indicating they were not selected. Consider how you can effectively use the multiplexer and logic gates to process the judges' votes and display the outcome. Complete your design by: **[2+10+8=20]**

**Multiplexer Data Input Configurations:**

* **Inputs like 0,1, 2, 4**  are connected to LOW (0), indicating non-winning conditions for these combinations of judges' votes.
* **Inputs 3, 5, and 6** are tied to the vote of J4 (represented as S = J4 in the table), which means the final decision for these scenarios is on J4's vote.
* **Input 7**  is connected to 1 meaning all judges voted in favor.

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**Question 2:** Using a decoder and external gates, design the combinational circuit defined by the following

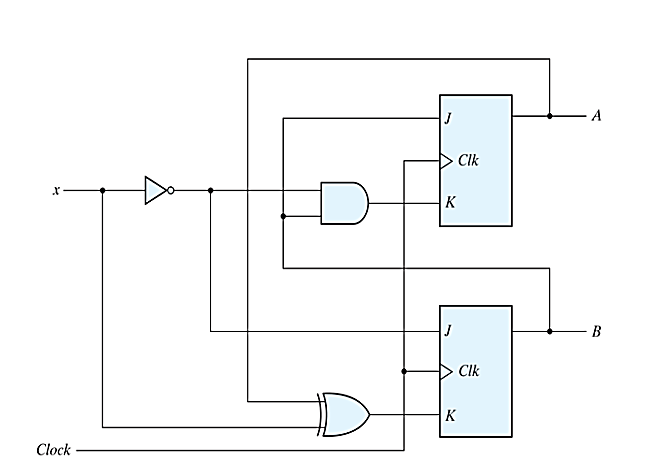
three Boolean functions & identify the minterms: **[3+3+3+1 = 10 marks]**

**Solution:**

A diagram of a decoder

Description automatically generated

**Question 3:** Given below is the circuit diagram of a synchronous (same clock is applied to both flip flops) sequential circuit with two flip flops (JK), one input x, and no output. Analyze the given circuit to find the: **[2+5+3=10 Marks]**

* State Equation(s)
* State Table
* State Diagram

**Equations:**

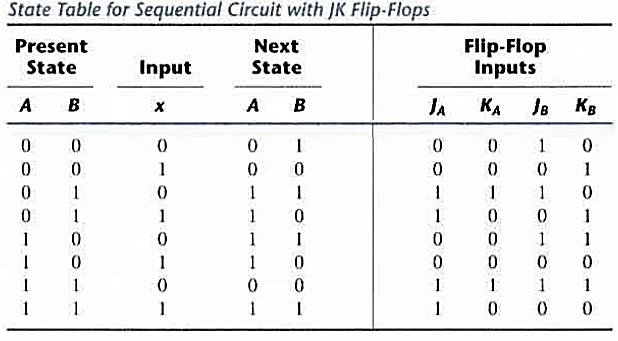
**JA** = B

**KA** = Bx'

**JB** = x'

**KB** = A'x + Ax' = A ⊕ x

**State Table:**



Next State Equations:

The next-state values can also be obtained by evaluating the state equations from the characteristic equation. This is done by using the following procedure:

1. Determine the flip-flop input equations in terms of the present state and input variables.

2. Substitute the input equations into the flip-flop characteristic equation to obtain the state equations.

3. Use the corresponding state equations to determine the next state values in the state table

A (t + 1) = JA' + K'A

B (t + 1) = JB' + K'B

Substituting the values of JA and KA from the input equations, we obtain the state equation for A:

**A (t + 1) = BA' + (Bx')'A**

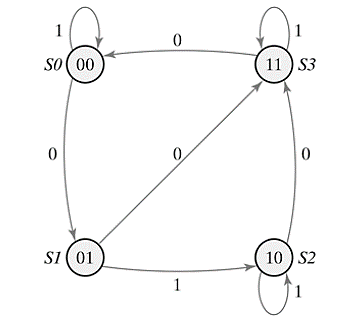
**= A'B + AB' + Ax**

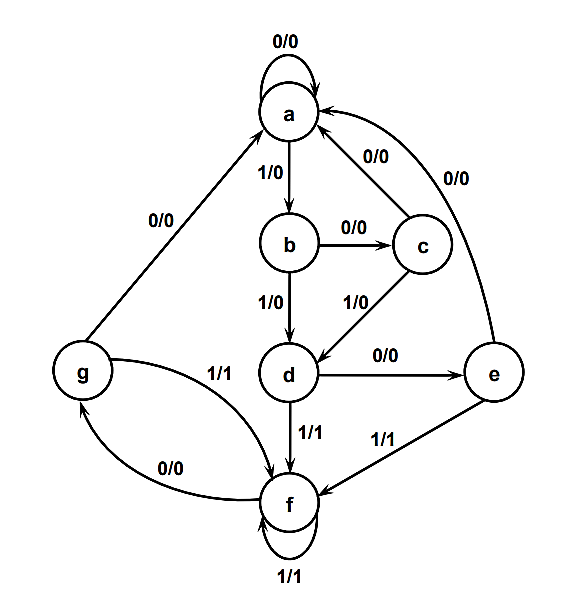
Substituting the values of JB and KB from the input equations, we obtain the state equation for A:

**B (t + 1) = x'B' + (A ⊕ x)'B**

**= B'x' + ABx + A'Bx'**

**State Diagram:**



**Question 4:** Given the following State diagram, perform the following **[5+5+5=15 marks]**

a) Construct the state table that corresponds to the given state diagram.

b) Reduce the state table to its minimized form step by step.

c) Redraw the reduced state diagram

A table with numbers and letters

Description automatically generated

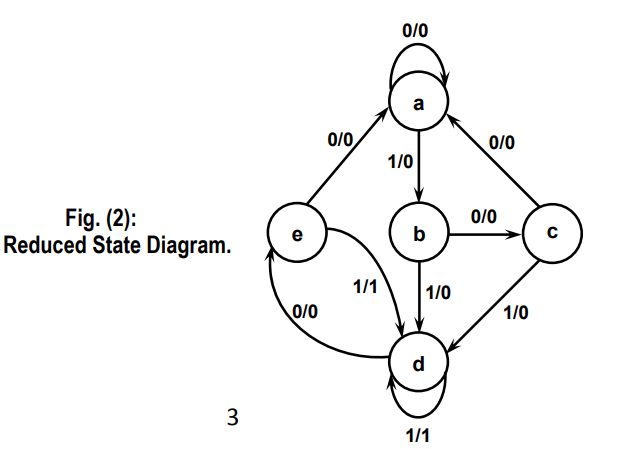
A table with numbers and letters

Description automatically generatedA table with numbers and letters

Description automatically generatedB)

Going through the state table, we look for two present states that go to the same next state and have the same output for both input combinations. **States (g) and (e) are two such states** The procedure of removing a state and replacing it by its equivalent is demonstrated in Table (2). **The row with present state (g) is removed and state (g) is replaced by state (e) each time it occurs in the next-state columns**.

States (f and d) are equivalent and state (f) can be removed and replaced by (d) as shown in Table (3)



Question 5: **Question 5: Design a sequential circuit with two JK flip-flops A and B and two inputs E and F. The circuit will follow some conditions that are broken down for you as followed for the ease of readability: [5+10+5 = 20 marks]**

1. **When E = 0:**
   * The circuit should maintain its current state, regardless of changes in F.
2. **When E = 1 and F = 1:**
   * The circuit will cycle through the following state transitions:

Start from 00 🡪 01 🡪 10 🡪 11 🡪 00. This cycle should repeat.

1. **When E = 1 and F = 0:**
   * The circuit will cycle through a different set of state transitions:
     + Start from 00, 🡪 11 🡪 10 🡪 01 🡪 00. This cycle should repeat.

Fill the table for this sequential circuit. Find the corresponding equations using k-maps, and draw the sequential circuit in neat and clean way.

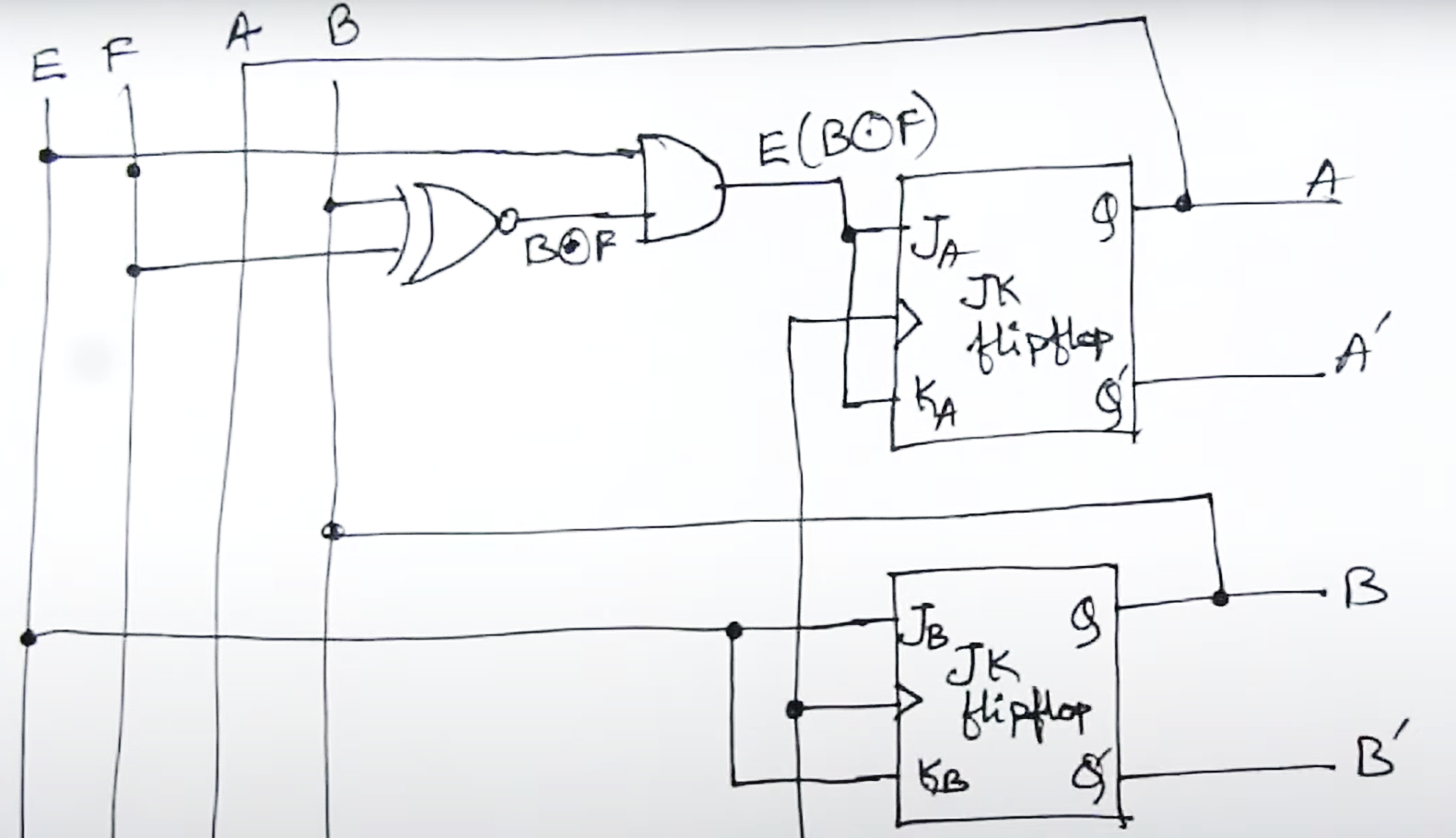
A table of numbers and letters

Description automatically generated

A group of squares with numbers and letters

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Diagram:



For Reference: <https://www.youtube.com/watch?v=t875Z-VCasQ>