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TE C32
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Assignment No : 1

Q.1 Design DFA to determine whether ternary number (base 3) is divisible by 5.

⇒ Sol^n :-

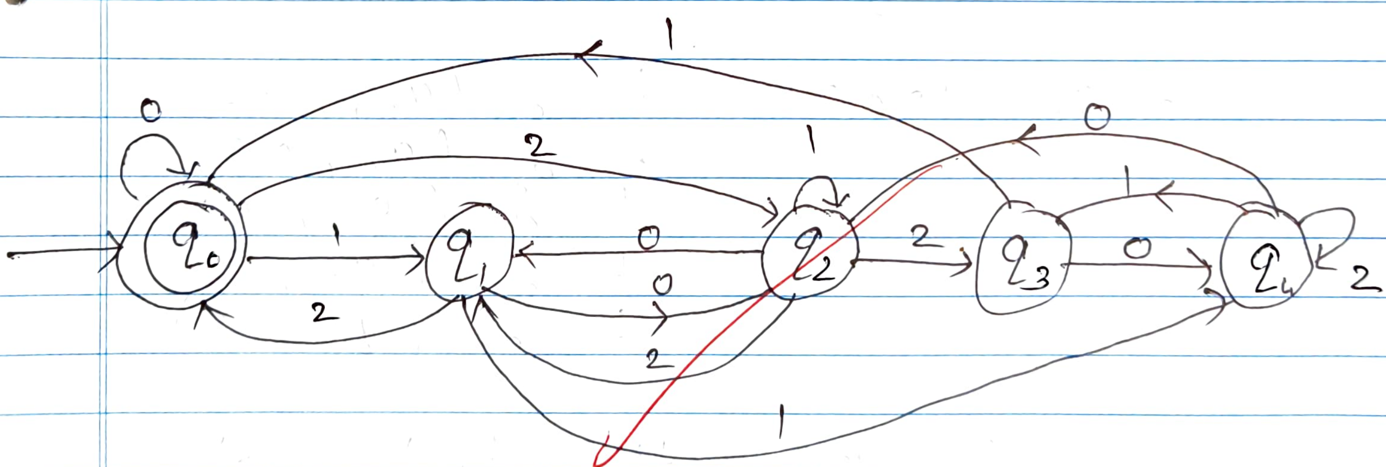
A ternary system has three alphabets

$$\Sigma = \{0, 1, 2\}$$

Base of ternary number is 3.

The running remainder could be :

$(0)_3 = 0$ → associated state, q_0
$(1)_3 = 1$ → associated state, q_1
$(2)_3 = 2$ → associated state, q_2
$(10)_3 = 3$ → associated state, q_3
$(11)_3 = 4$ → associated state, q_4



$M = (Q, \Sigma, \delta, q_0, F)$

$Q = \{q_0, q_1, q_2, q_3, q_4\}$

$\Sigma = \{0, 1, 2\}$

$q_0 = q_0$

$F = q_0$

- δ (Transition table) :

$Q \backslash \Sigma$	0	1	2
q_0	q_0	q_1	q_2
q_1	q_3	q_4	q_0
q_2	q_1	q_2	q_3
q_3	q_4	q_0	q_1
q_4	q_2	q_3	q_4

- <u>Simulation</u>

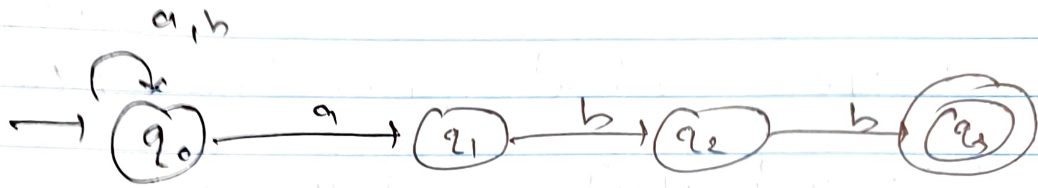
Input String : 12021

$\delta(q_0, 12021) \vdash \delta(q_1, 2021)$
$\vdash \delta(q_0, 021)$
$\vdash \delta(q_0, 21)$
$\vdash \delta(q_2, 1)$
$\vdash \delta(q_1, \varepsilon)$

$\therefore q_1$ is not a final state.
$\therefore$ 12021 is not accepted by DFA.

Q. 2 Construct NFA that accepts set of all string over $\{a, b\}$ ending with 'abb'. Convert this NFA to equivalent DFA.

→ Sol^n:-



NFA can be defined as-

$M = \{Q, \Sigma, \delta, q_0, F\}$

$Q = \{q_0, q_1, q_2, q_3\}$

$q_0 = q_0$

$F = \{q_3\}$

$\Sigma = \{a, b\}$

$\delta \Rightarrow$

	a	b
q_0	$\{q_0, q_1\}$	$\{q_0\}$
q_1	$\emptyset$	$\{q_2\}$
q_2	$\emptyset$	$\{q_3\}$
q_3	$\emptyset$	$\emptyset$

- NFA to DFA

⇒

Step I: Take $\{q_0\}$ as the initial state

$\delta(q_0, a) = \{q_0, q_1\}$

$\delta(q_1, b) = \{q_0\}$

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Step 2: New subset generated $\{q_0, q_1\}$

$$\delta(\{q_0, q_1\} \cup a) = \{q_0, q_1\}$$
$$\delta(\{q_0, q_1\} \cup b) = \{q_0, q_2\}$$

→ new state

Step 3: New subset generated $\{q_0, q_2\}$

$$\delta(\{q_0, q_2\} \cup a) = \{q_0, q_1\}$$
$$\delta(\{q_0, q_2\} \cup b) = \{q_0, q_3\}$$

Step 4: $\{q_0, q_3\}$

$$\delta(\{q_0, q_3\} \cup a) = \{q_0, q_1\}$$
$$\delta(\{q_0, q_3\} \cup b) = \{q_0\}$$

No new state generated

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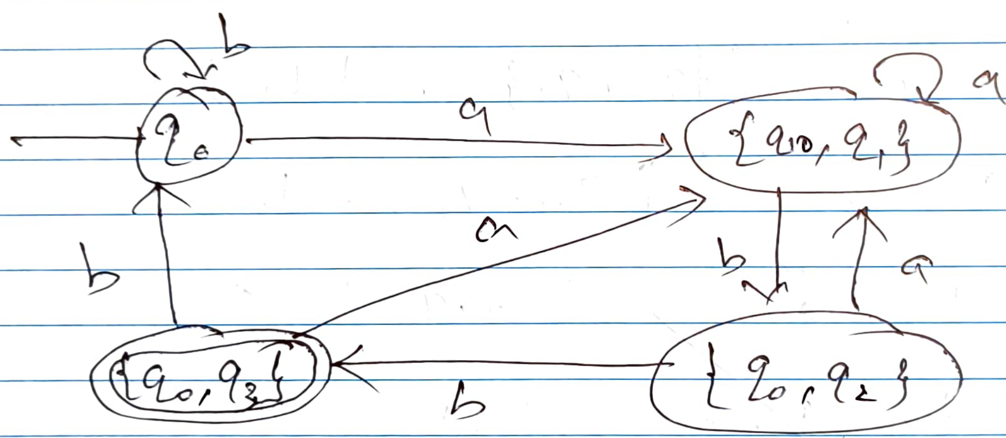
Step 5 : New transition table.

$Q \backslash \Sigma$	a	b
q_0	$\{q_0, q_1\}$	$\{q_0\}$
$\{q_0, q_1\}$	$\{q_0, q_1\}$	$\{q_0, q_2\}$
$\{q_0, q_2\}$	$\{q_0, q_1\}$	$\{q_0\}$
$\{q_0, q_3\}$	$\{q_0, q_1\}$	$\{q_0, q_3\}$

Transition diagram :



Above DFA can be represented as.

$M' = \{Q', \Sigma', \delta', q_0', F'\}$

$Q' = \{\{q_0\}, \{q_0, q_1\}, \{q_0, q_2\}, \{q_0, q_3\}\}$

$\Sigma' = \{a, b\}$

$q_0' = q_0$

$F' = \{q_0, q_3\}$

- <u>Simulation</u>

$\Rightarrow$ a a b a b b

$\delta'(q_0, aababb)$

$\vdash \delta'(\{q_0, q_1\}, ababb)$

$\vdash \delta'(\{q_0, q_1\}, babb)$

$\vdash \delta'(\{q_0, q_2\}, abb)$

$\vdash \delta'(\{q_0, q_1\}, bb)$

$\vdash \delta'(\{q_0, q_2\}, b)$

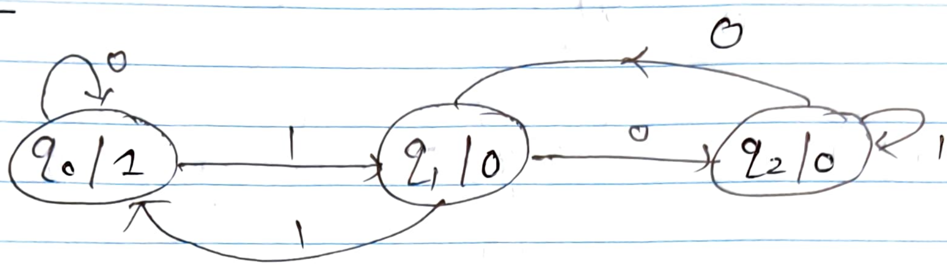
$\vdash \delta'(\{q_0, q_3\}, \epsilon)$

$\vdash$ Final state.

Hence, input string accepted.

Q.3 Construct Moore Machine to find out the residue modulo-3 binary numbers.

→ Soln:-



- State q_0 is the running remainder as 0.
- State q_1 is the running remainder as 1
- State q_2 is for the running remainder as 2.

Output 1 indicates divisibility by 3

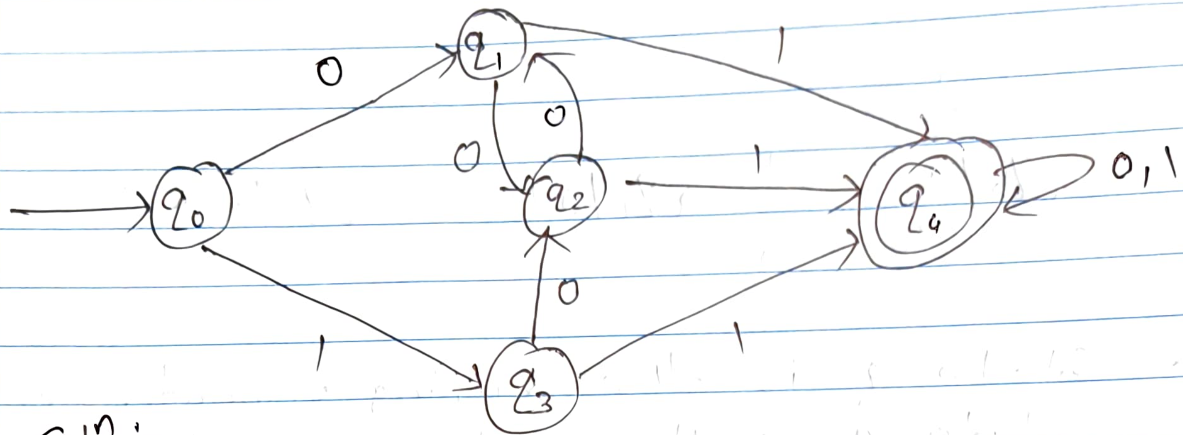
Output 0 indicates that the number is not divisible by 3.

∴ Required regular expression -

⇒

$$(0 + (1+01)^* 00)^*$$

Q.4 Minimise following DFA.

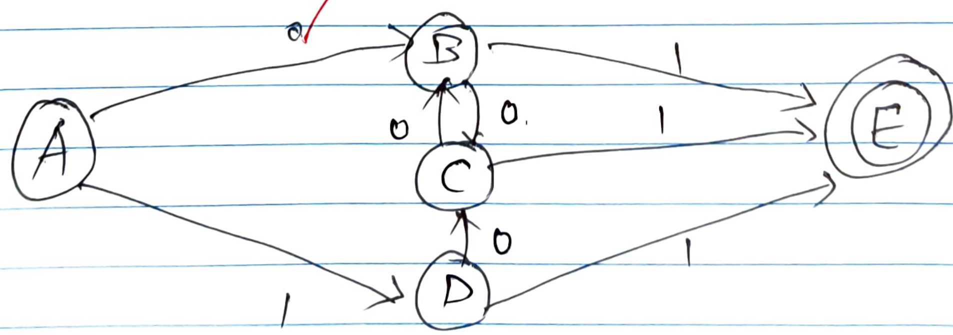


⇒ <u>Solⁿ :-</u>

<u>Step I</u>: Draw Transition Table

Q \ Σ	0	1
q_0	q_1	q_3
q_1	q_2	q_4
q_2	q_1	q_4
q_3	q_2	q_4
q_4	q_4	q_4

- Consider $q_0 = A$, $q_1 = B$, $q_2 = C$, $q_3 = D$, $q_4^* = E$
- The diagram is -



Step 2:

B				
C				
D				
E				
	A	B	C	D

Mark all final state & non final.
(B, E), (C, E), (D, E).

Step 3: Process all the states.

1) (A, E)

⇒ $\delta(A, 0) = B$, $\delta(E, 0) = B$
$\delta(A, 1) = C$, $\delta(E, 1) = E$

2) (B, E)

⇒ $\delta(B, 0) = C$, $\delta(E, 0) = E$
$\delta(B, 1) = E$, $\delta(E, 1) = E$

Not equivalent

3) (C, E)

⇒ $\delta(C, 0) = B$, $\delta(E, 0) = E$
$\delta(C, 1) = E$, $\delta(E, 1) = E$

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4) $\delta(D, E)$

$\Rightarrow$ $\delta(D, 0) = C$, $\delta(E, 0) = E$

$\delta(D, 1) = E$, $\delta(E, 1) = E$

5) (A, D)

$\Rightarrow$ $\delta(A, 0) = B$, $\delta(D, 0) = D$

$\delta(A, 1) = C$, $\delta(D, 1) = E$

6) (B, D)

$\Rightarrow$ $\delta(B, 0) = \{C, E\}$, $\delta(D, 0) = E$

$\delta(B, 1) = C$, $\delta(D, 1) = E$

Equivalent

7) (C, D)

$\Rightarrow$ $\delta(C, 0) = B$, $\delta(D, 0) = E$

$\delta(C, 1) = C$, $\delta(D, 1) = E$

Equivalent

8) (C, A)

$\Rightarrow$ $\delta(C, 0) = B$, $\delta(C, 0) = E$

$\delta(C, 1) = B$, $\delta(C, 1) = E$

9) (B, C)

$\Rightarrow$ $\delta(B, 0) = E$, $\delta(C, 0) = E$

$\delta(B, 1) = B$, $\delta(C, 1) = E$

10) (A, B)

$\Rightarrow$

$\delta(A, 0) = B$, $\delta(B, 0) = E$

$\delta(A, 1) = C$, $\delta(B, 1) = D$

- Minimised DFA

⇒