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Theory of Computation

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Q1) Prove:
Soln:
$$1+2+3+ \ldots\ldots + n = n(n+1)/2 \quad \text{---}(a)$$

$$\sum_{i=1}^{n} i = \frac{n(n+1)}{2} \quad \text{---}(i)$$

As given:

if $$\sum_{i=1}^{n} i = n(n+1)/2$$

then $$\sum_{i=1}^{n} i + n+1 = \sum_{i=1}^{n+1} i$$

L.H.S: from eq (i)

$$\Rightarrow \frac{n(n+1)}{2} + n+1$$

$$\frac{n(n+1)+2n+2}{2} = \frac{n^2+n+2n+2}{2} = \frac{n^2+3n+2}{2}$$

R.H.S. $$\sum_{i=1}^{n+1} i = \frac{(n+2)(n+1)}{2}$$

$$= \frac{n^2+n+2n+2}{2} = \frac{n^2+3n+2}{2}$$

L.H.S = R.H.S Proved.

Q2)(i) $A\{1,2,3,4\}$ $B=\{2,4,3,1\}$

Since $\forall x \in A \ni x \in B$
Hence, both set A and B are equal.

(ii) $A=\{1,3,5,7\}$ $n=4$

No. of subset $=2^4=16$

$\{\}, \{1\}, \{3\}, \{5\}, \{7\}, \{1,3\}, \{1,3,5\}, \{1,3,5,7\}, \{1,3\}, \{1,5\}, \{1,3,7\}$
$\{3,5\}, \{3,5,7\}, \{5,7\}, \{1,7\}, \{1,5\}$

(iii) Sol:- $A=\{x \in N \mid x>1\}$.

(iv) $A=\{1,3,5,7,9,11\}$, $B=\{1,2,3,13\}$

$A-B=\{5,7,9,11\}$ $B-A=\{3,13\}$.

(v) $A\cup(B\cup C)$ $A=\{1,3,5\}$, $B=\{2,4,6\}$
$=A\cup B\cup C$ $C=\{1,5,7\}$

$=\{1,2,3,4,5,6,7\}$ Ans.

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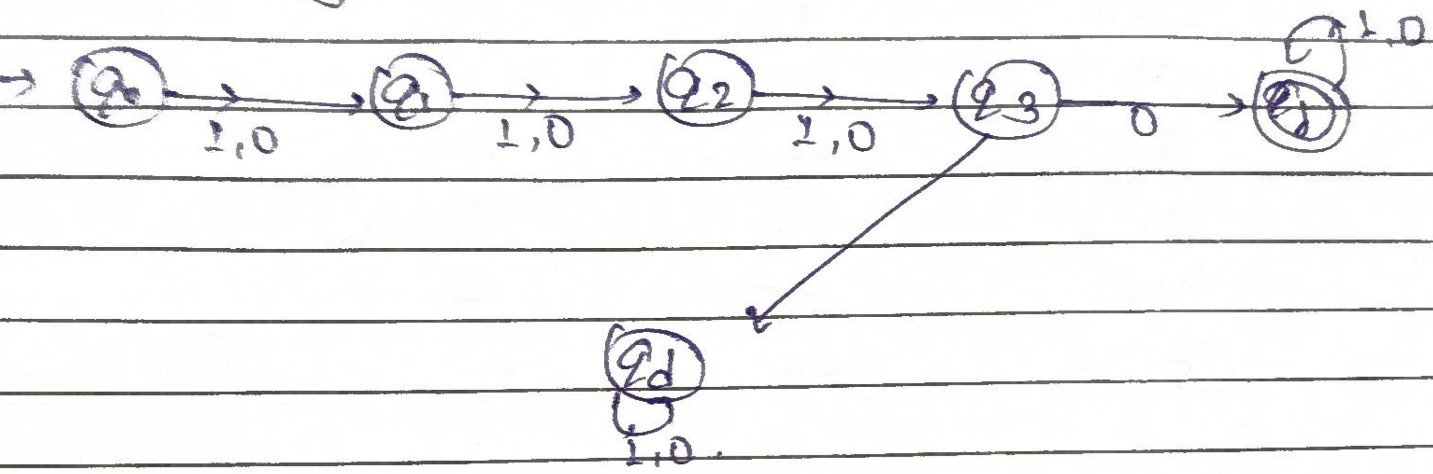
Q3) L = {w | w ∈ {0,1} and 4th symboll from beiging is 0.

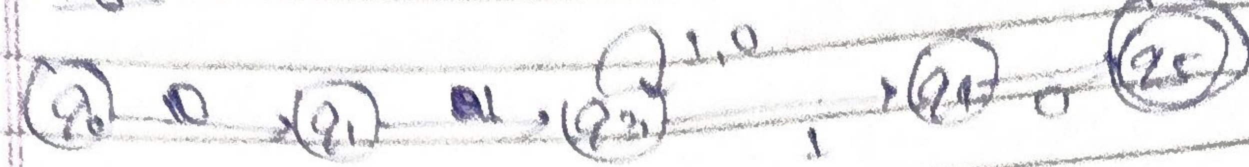
DFA Diagram:-

→ intial state = q_0
finial state



→ Reverse :-

(Q) NFA



initial = q0

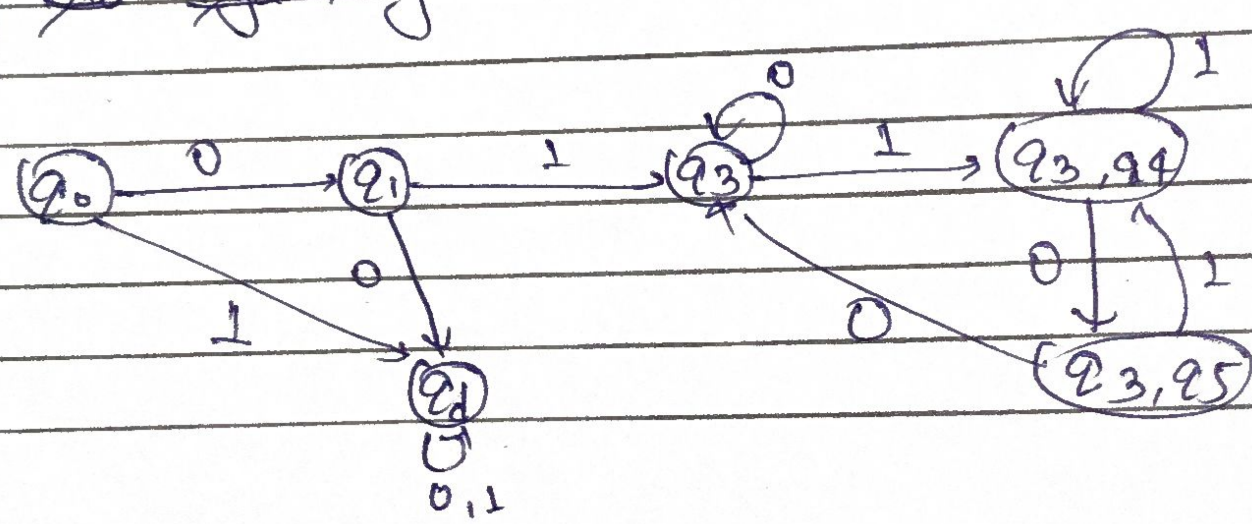
Transition table for NFA:-

	input	
State	0	1
→ q0	q1	q3
q1	–	q3, q4
q3	q3	–
q4	q5	–
q5	–	

DFA table:-

	input	
State	0	1
→ q0	q1	q3
q1	–	{q3, q4}
q3	q3	{q3, q4}
{q3, q4}	{q3, ~~q4~~, q5}	{q3, q4}
{q3, q5}	q3	q3, q4

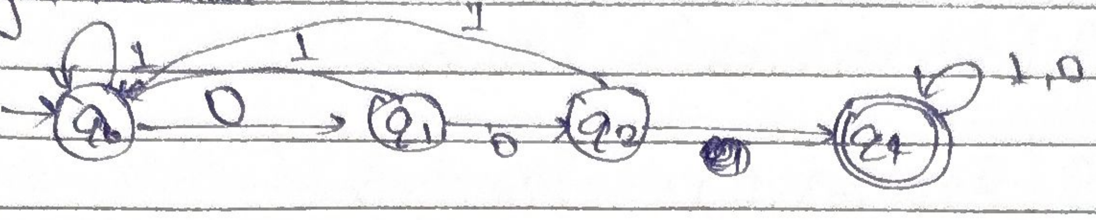
~~Dia~~ Dfa Diagram:-



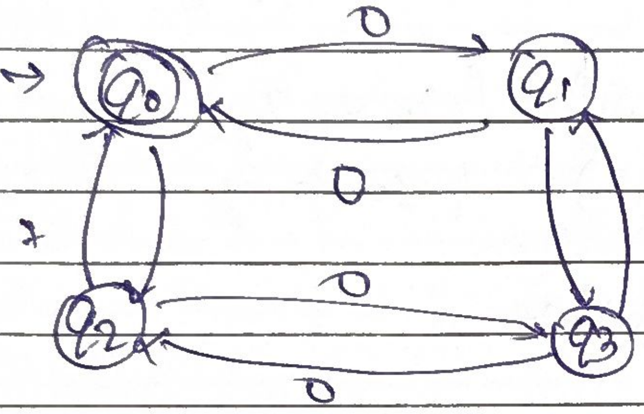
Q5) $\Sigma = \{0,1\}$.

$L = \{000, 1000, 10001 \dots\}$

DfA machine:-



Q6) $\Sigma = \{0,1\}$.



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final and initial sta $= q_0$

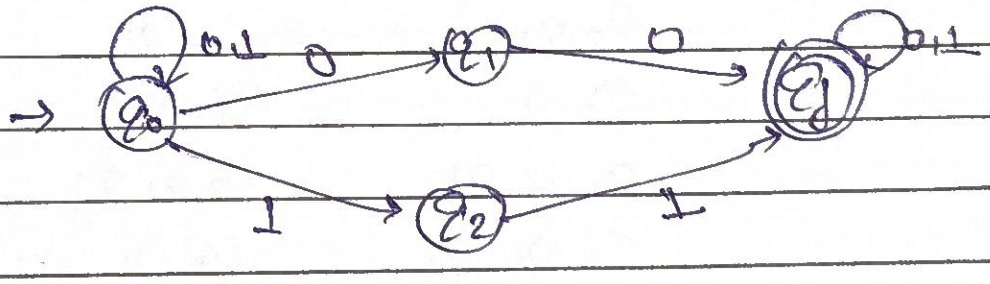
$Q = \{q_0, q_1, q_2, q_3\}$

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

$q_0 = q_0$

$f = q_0$.

Q7) NFA to DfA



NFA - table:-

Input

State	0	1
$\rightarrow q_0$	$\{q_0, q_1\}$	$\{q_0, q_2\}$.
q_1	q_f	–
q_2	–	q_f
q_f	q_f	q_f.

Transition function for NFA:-

$\delta(q_0, 0) = \{q_0, q_1\}$
$\delta(q_0, 1) = \{q_0, q_2\}$

$\delta(\{q_0, q_1\}, 0) = \{q_0, q_1, q_f\}$.
$\delta(\{q_0, q_1\}, 1) = \{q_0, q_2\}$.

$\delta(\{q_0, q_2\}, 0) = \{q_0, q_1\}$
$\delta(\{q_0, q_2\}, 1) = \{q_0, q_2, q_f\}$.

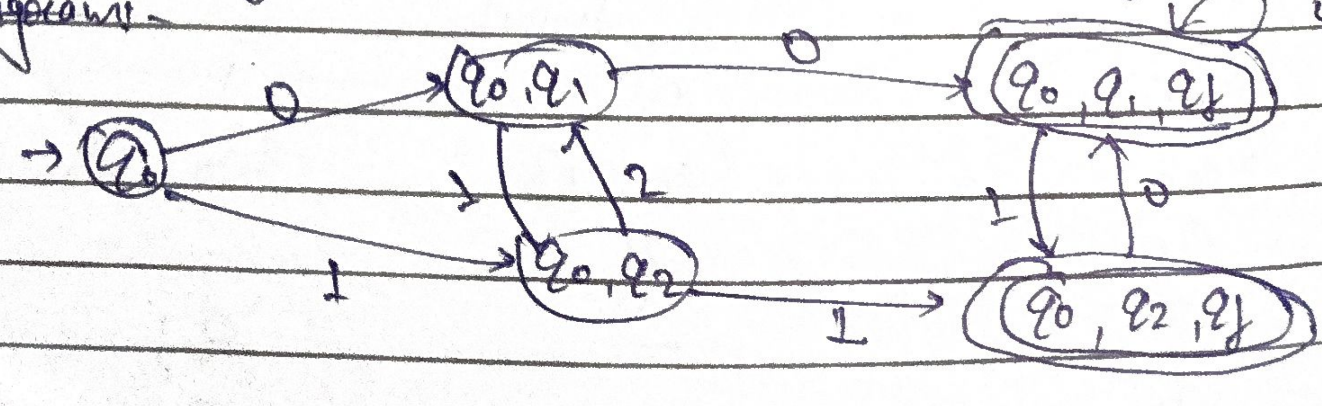
$\delta(\{q_0, q_1, q_f\}, 0) = \{q_0, q_1, q_f\}$
$\delta(\{q_0, q_1, q_f\}, 1) = \{q_0, q_2, q_f\}$.

$\delta(\{q_0, q_2, q_f\}, 0) = \{q_0, q_1, q_f\}$
$\delta(\{q_0, q_1, q_f\}, 1) = \{q_0, q_2, q_f\}$

DFA - transition table:-

State	Input 0	1
$\rightarrow q_0$	q_0, q_1	q_0, q_2
q_0, q_1	q_0, q_1, q_f	q_0, q_2
q_0, q_2	q_0, q_1	q_0, q_2, q_f
q_0, q_1, q_f	q_0, q_1, q_f	q_0, q_2, q_f
q_0, q_2, q_f	q_0, q_1, q_f	q_0, q_2, q_f.

Diagram:-



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Q.)
~~Read~~ Procedure of minization:-

→ Minimization of DFA is the process of finding equivalent DFA with minimum possible state.

Step 1:- Pre-processing Elemination of unreachable State.

→ Discard any state that cannot reached from start state.

Step 2:- Initial Partion:-

· Action:- Group into the two initial Partion.

P_0:- All-non finial State

P_2:- All final State.

Step 3:- Iterative Partion (Core algorithm):-

Iterate:- iterate until no Partion split $P_{next} = P_{curr}$

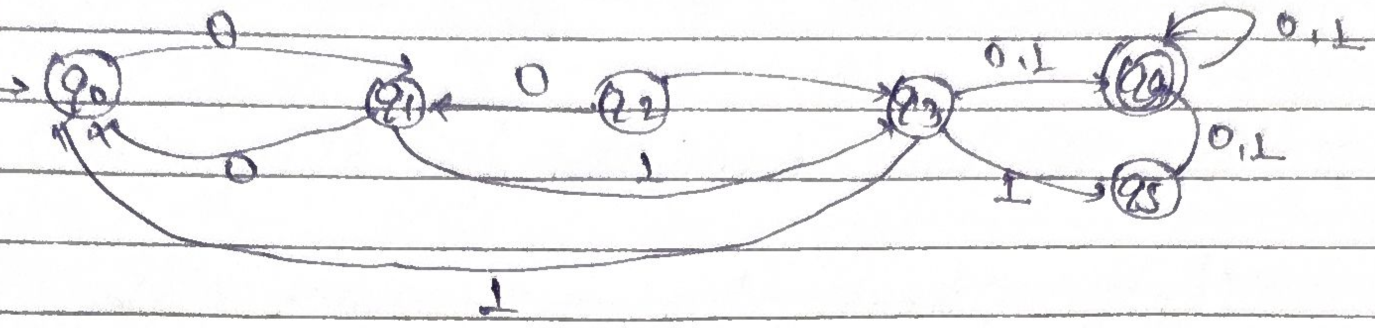
~~Check:- for all State check~~

Refine:- Check each Partion P_i for every enput

Check:- for all state check the $\delta(p,a)$ and $\delta(q,a)$.

Split:- if p and q have same Partion the p,q sam...

Step:- Construct minimal DfA by eleminating Same state



initial state :- q0
final state :- q4

→ NFA - transition table

State	input 0	1
→ q_0	$\{q_1\}$	$\{q_3\}$
q_1	q_0	q_3
q_2	q_1	q_3
q_3	q_5	$\{q_4, q_5\}$
q_4	q_4	q_4
q_5	q_4	q_4

DfA - table :-

State	input 0	1
→ q_0	q_1	q_3
q_1	q_0	q_3
q_3	q_5	q_3
q_5	q_4	$\{q_4, q_5\}$
$\{q_4, q_5\}$	q_4	q_4
q_4	q_4	q_4

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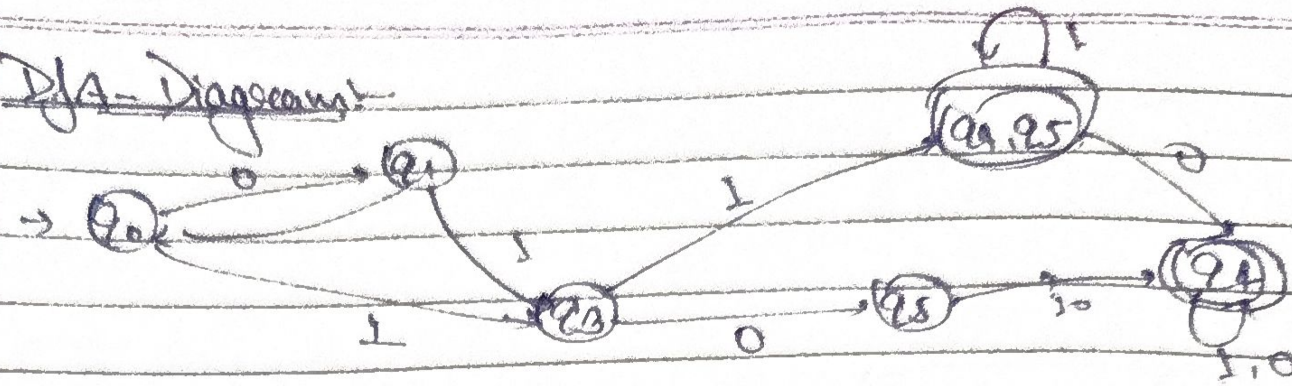
DFA Diagram:-



Now, we have minimize this step:-

Step 1:- Check for unreachable state.

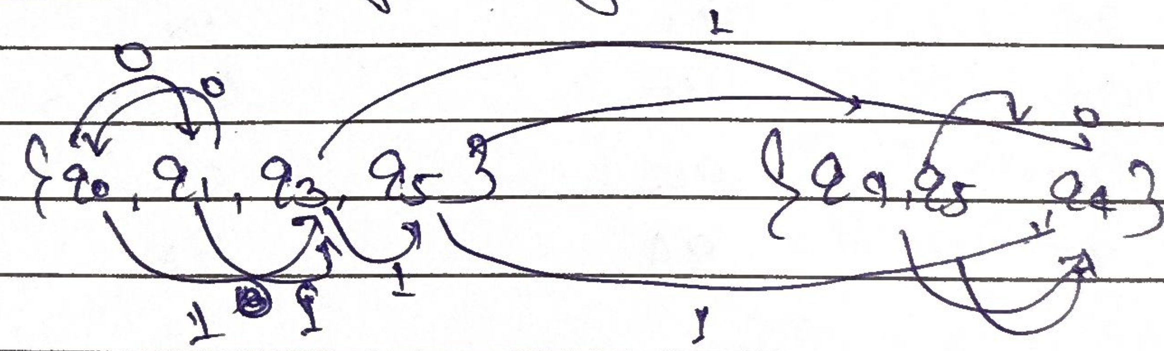
there no unreachable state.

Step 2:- Partition:-

$P_0 = \{q_0, q_1, q_3, q_5\} \rightarrow$ No final

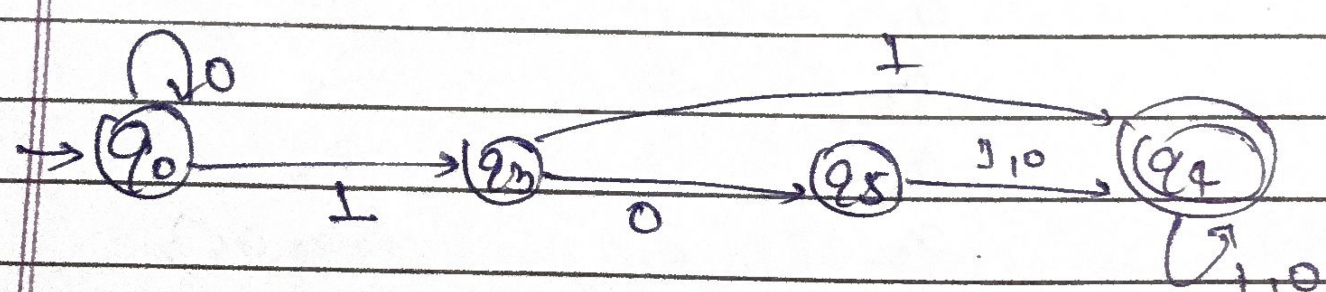
$P_1 = \{\{q_4, q_5\}, q_4\} \rightarrow$ final state.

Step 3:- Check for Symbol all input Symbol:-



→ q_0 and q_1 is ~~Same~~ equavalent

→ q_4, q_5 and q_5 equavalent.



Ans.

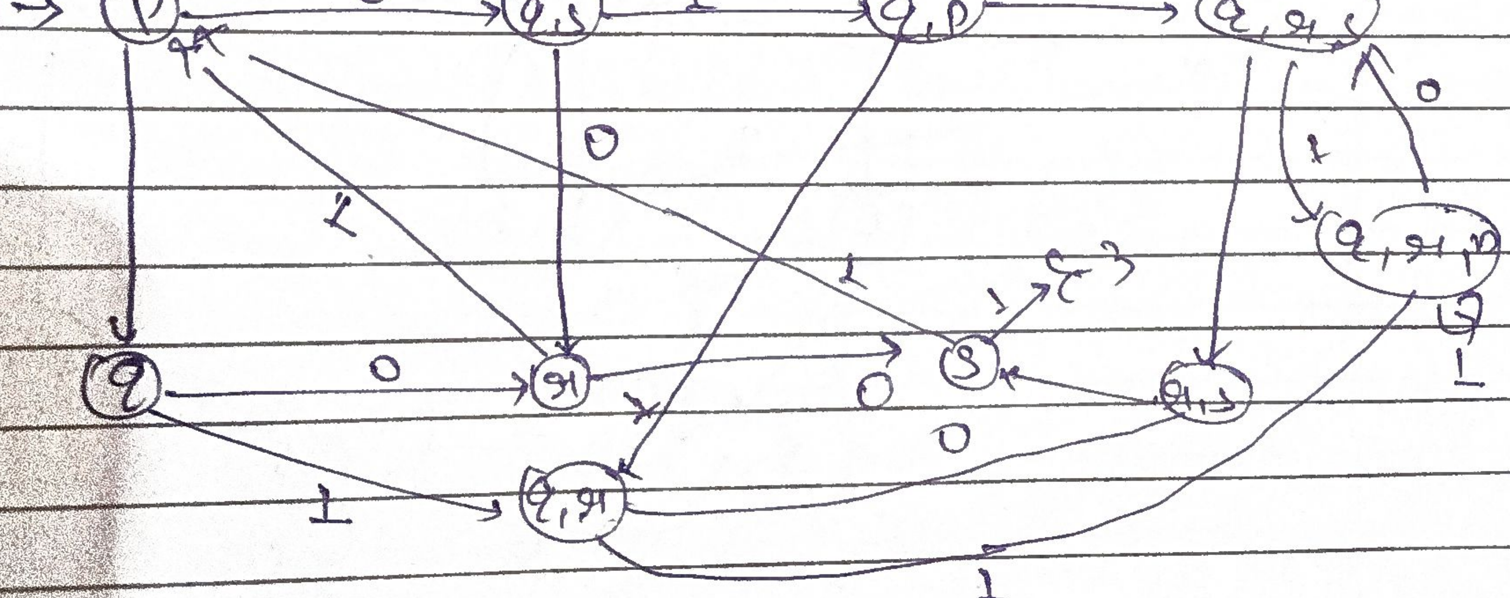
Q10) Sol^n

State	Input 0	Input 1
p	{p, s}	{q}
q	{r}	{q, r}
r	{s}	{p}
s	—	{p}.

DFA-table

δ	Input 0	Input 1
p	{q, s}	{q}
q	{r}	{q, r}
{q, s}	{r}	{q, p}
{r}	{s}	{p}
{q, r}	{r, s}	{q, r, p}.
{q, p}	{q, r, s}	{q, r}.
{s}	{–}	{p}
{r, s}	{s}	{p}
{p, q, r}	{q, r, s}	{q, r, p}
{q, r, s}	{r, s}	{p, q, r}.

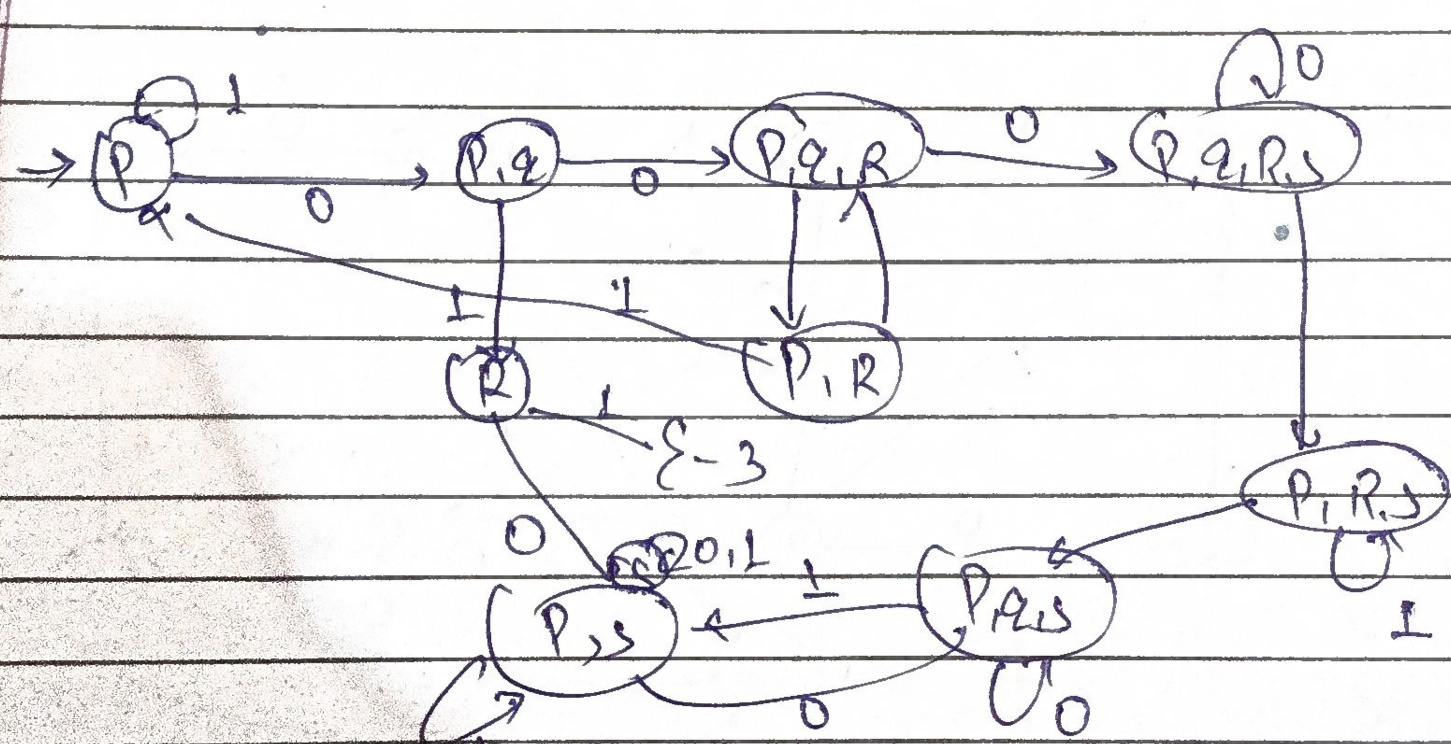
DFA:



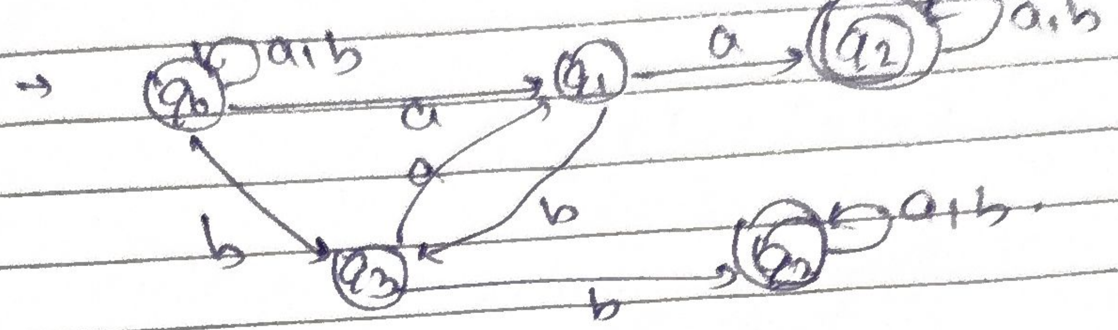
Q11)

	input	
State	0	1
P	{P,Q}	P
Q	R	R
R	S	—
S	S	S

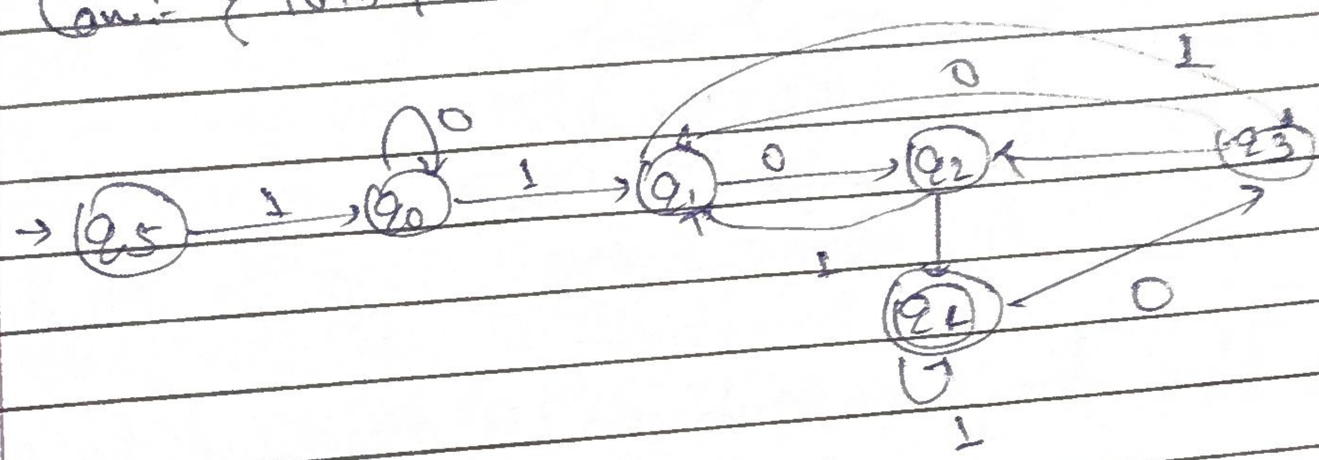
	input	
State	0	1
{P}	{P,Q}	{P}
{P,Q}	{P,Q,R}	{R}
{P,Q,R}	{P,Q,R,S}	{P,R}
{R}	{S}	{-}
{P,Q,R,S}	{P,Q,R,S}	{P,R,S}
{P,R}	{P,Q,R}	{P}
{S}	{S}	{S}
{P,R,S}	{P,Q,S}	{P,R,S}.
{P,Q,S}	{P,Q,S}	{P,S}
{P,S}	{P,Q,S}	{P,S}.



Q13 L- {aa, bb, baab, abba. .... }



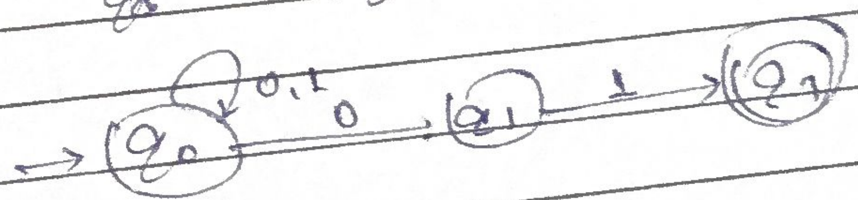
Q14) Lan:- { 1010, 10100.... }



T.T:-

δ	0	1
→ q5	qf	q0
q0	q0	q1
q1	q2	q3
q2	q4	q0
q3	q1	q2
q4	q3	q4.
qd	qd	qd.

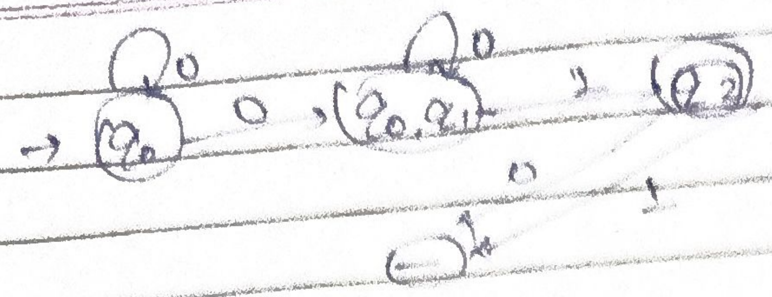
Q15. NFA:



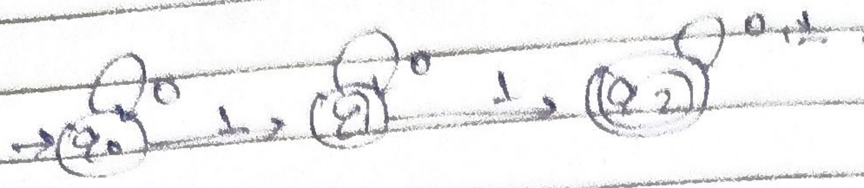
Transtable

δ	0	1
→ q0	q0q1	q0
q1	—	q2
q2	—	—

δ	0	1
→ q0	q0q1	q0
q0q1	q0q1	q2
q2	—	—



(19)



Checking for 101101

for 1 :- $q_0 \xrightarrow{1} q_1$

0 :- $q_0 \xrightarrow{0} q_1$

for 1 :- $q_1 \xrightarrow{1} q_2$

for 1 :- $q_2 \xrightarrow{1} q_2$

for 0 :- $q_2 \xrightarrow{0} q_2$

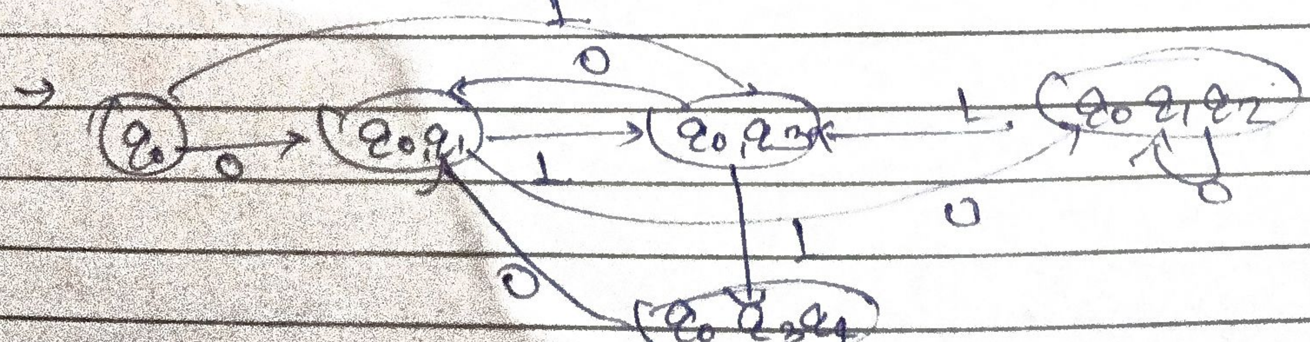
for → $q_2 \rightarrow q_2$. q_2 is final state.

Hence the given automata is acceptable for given string.

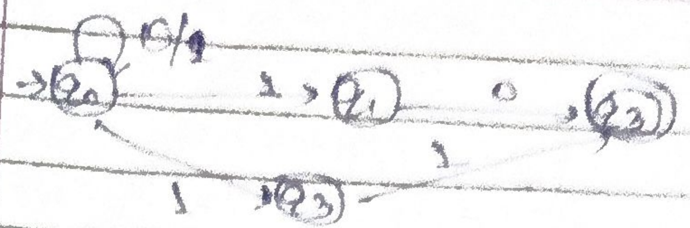
(20)

δ	0	1
q_0	$q_0 q_1$	$q_0 q_3$
q_1	q_2	ϕ
q_2	ϕ	ϕ
q_3	ϕ	q_4
q_4	ϕ	ϕ

δ	0	1
q_0	$q_0 q_1$	$q_0 q_3$
$q_0 q_1$	$q_0 q_1 q_2$	$q_0 q_3$
$q_0 q_3$	$q_0 q_1$	$q_0 q_3 q_4$
$q_0 q_1 q_2$	$q_0 q_1 q_2$	$q_0 q_3$
$q_0 q_3 q_4$	$q_0 q_1$	$q_0 q_3 q_4$



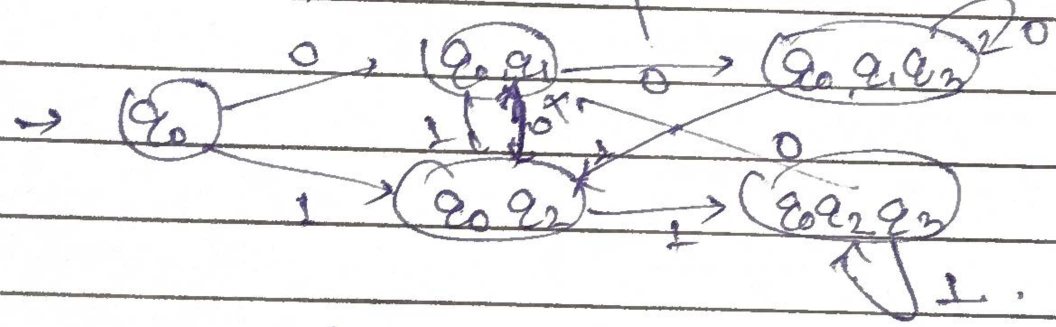
(Q2.)



T.T.:

δ	0	1
→q_0	q_1	q_0q_3
q_1	q_3	—
q_2	—	q_3
q_3	—	—

δ	0	1
→q_0	q_0q_1	q_0q_2
q_0q_1	$q_0q_1q_3$	q_0q_2
q_0q_2	q_0q_1	$q_0q_2q_3$
$q_0q_1q_3$	$q_0q_1q_3$	q_0q_3
$q_0q_2q_3$	q_0q_1	$q_0q_2q_3$.

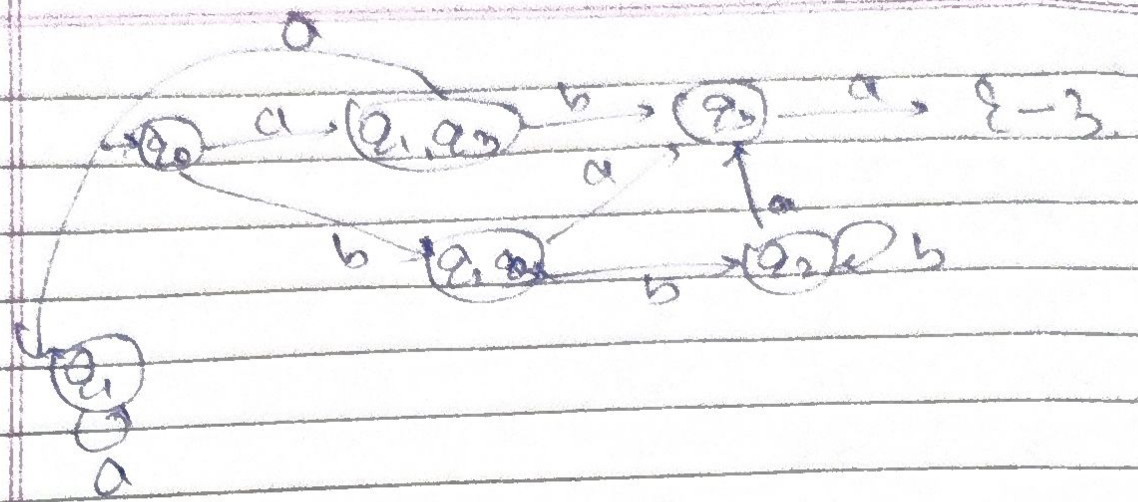


Ques

δ	a	b
→q_0	q_1q_3	q_2q_3
q_1	q_1	q_3
q_2	q_3	q_2
q_3	—	—

NFA

δ	a	b
→q_0	q_1q_3	q_2q_3
q_1q_3	q_1	q_3
q_2q_3	q_3	q_2
q_3	—	—
q_2	q_3	q_2
q_1	q_1	q_3



Q5. (i) Containing exactly 2 0's