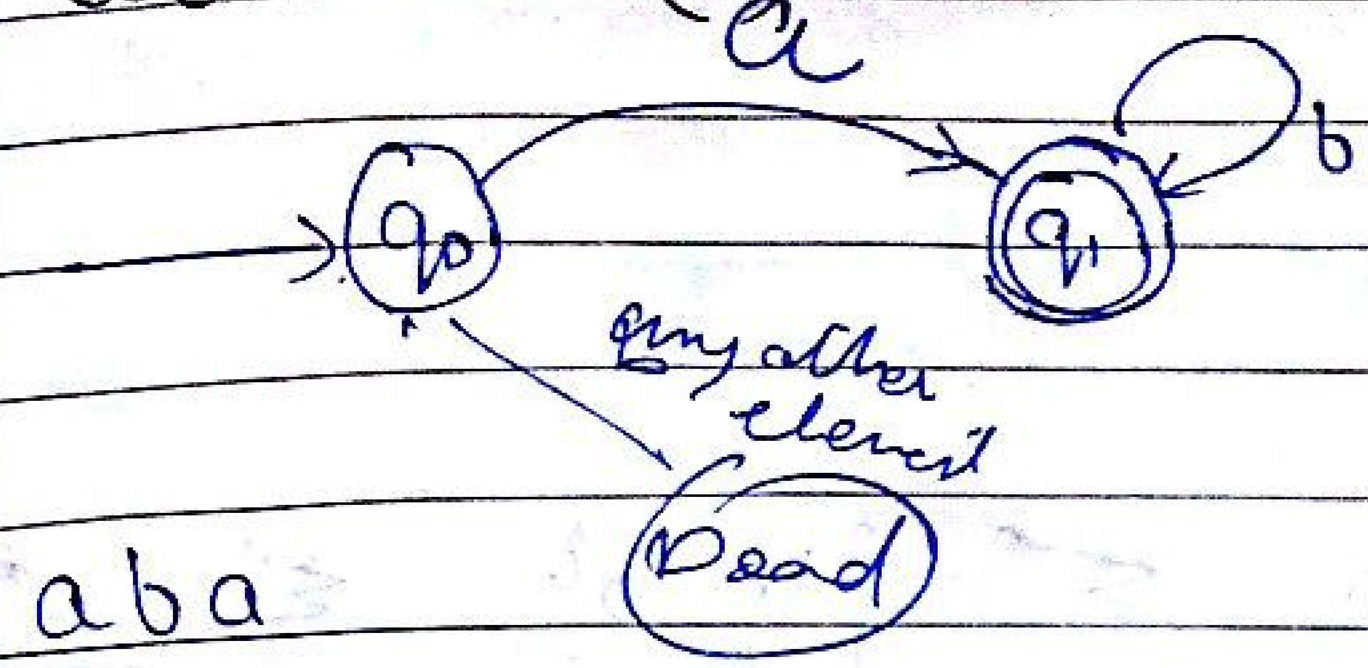
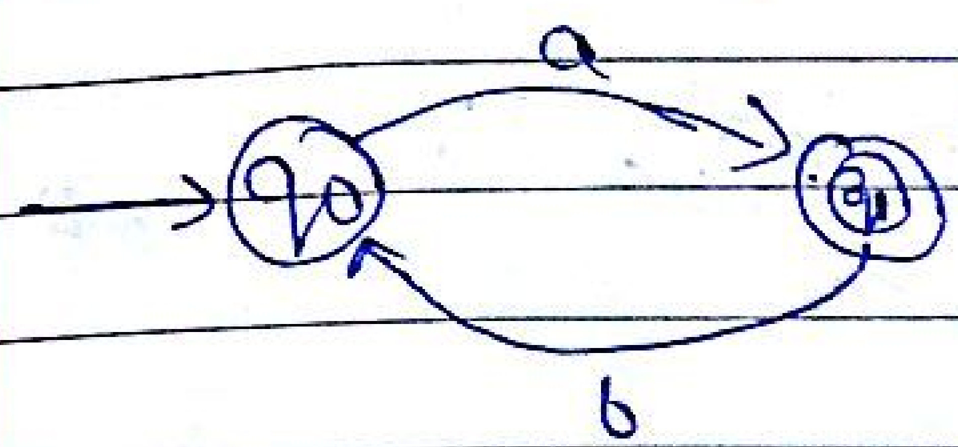
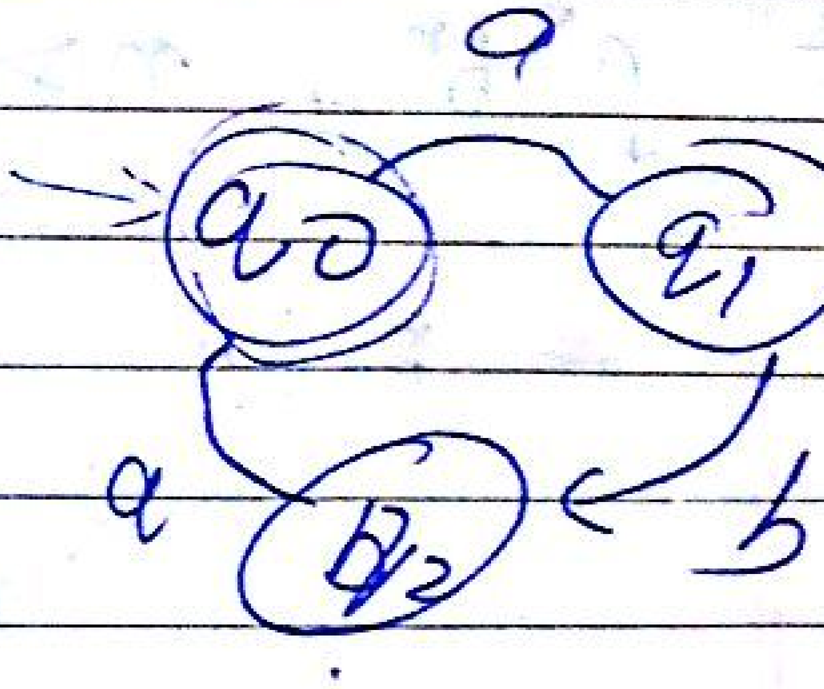
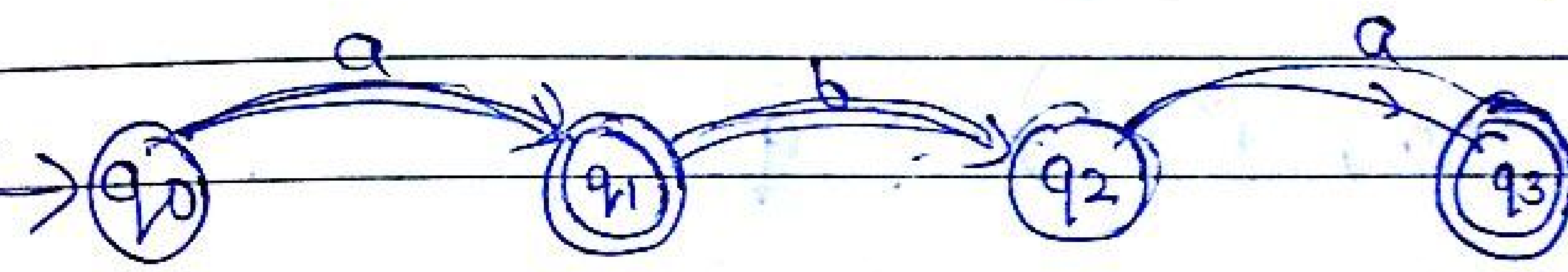
Eg: $ab^n \rightarrow a(b)^*$



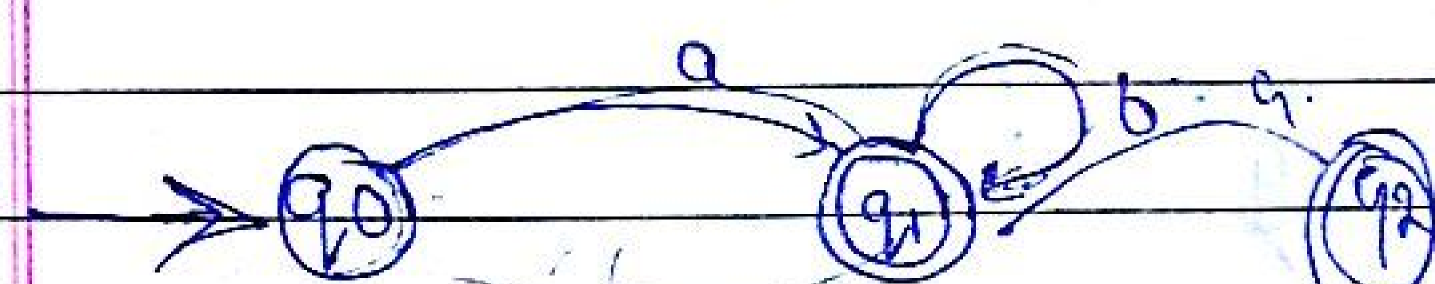
→ aba





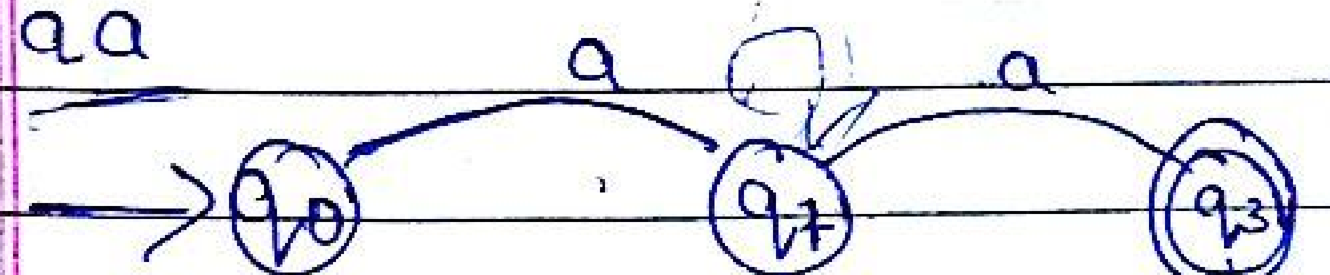


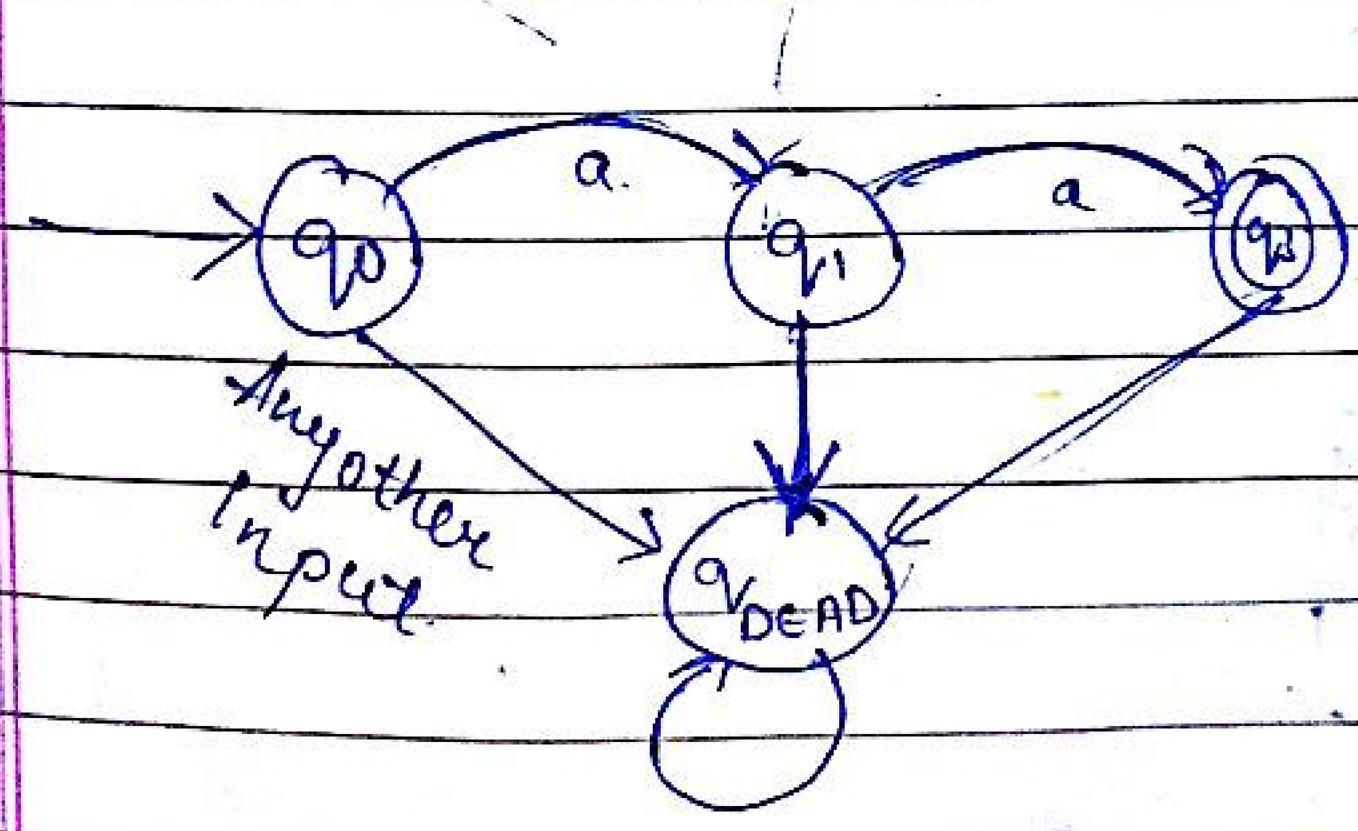
→ $ab^n a \rightarrow a(b)^* a$



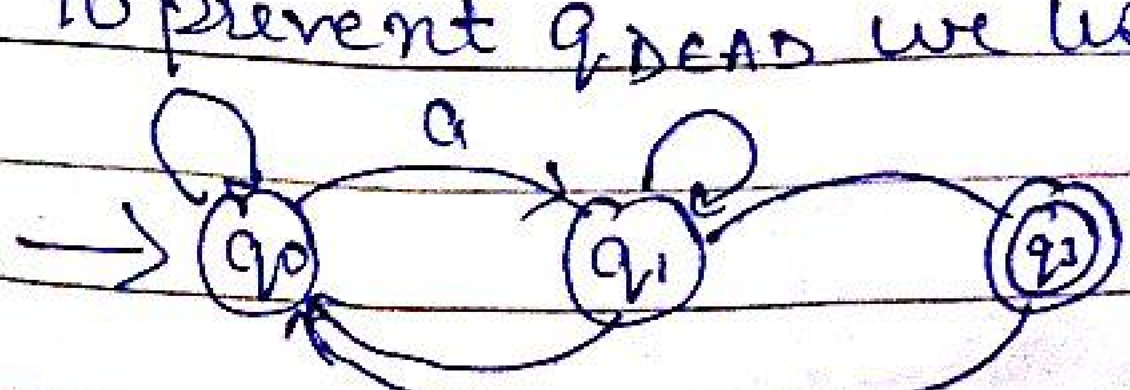
$\varepsilon \{a, b\} =$

→ aa

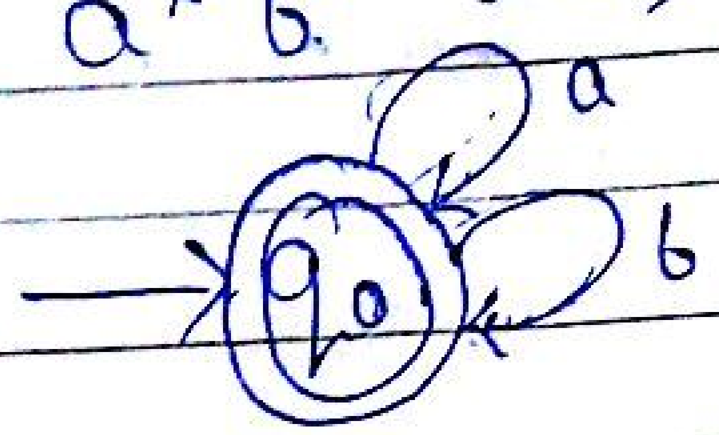




To prevent q_{DEAD} we use try catch

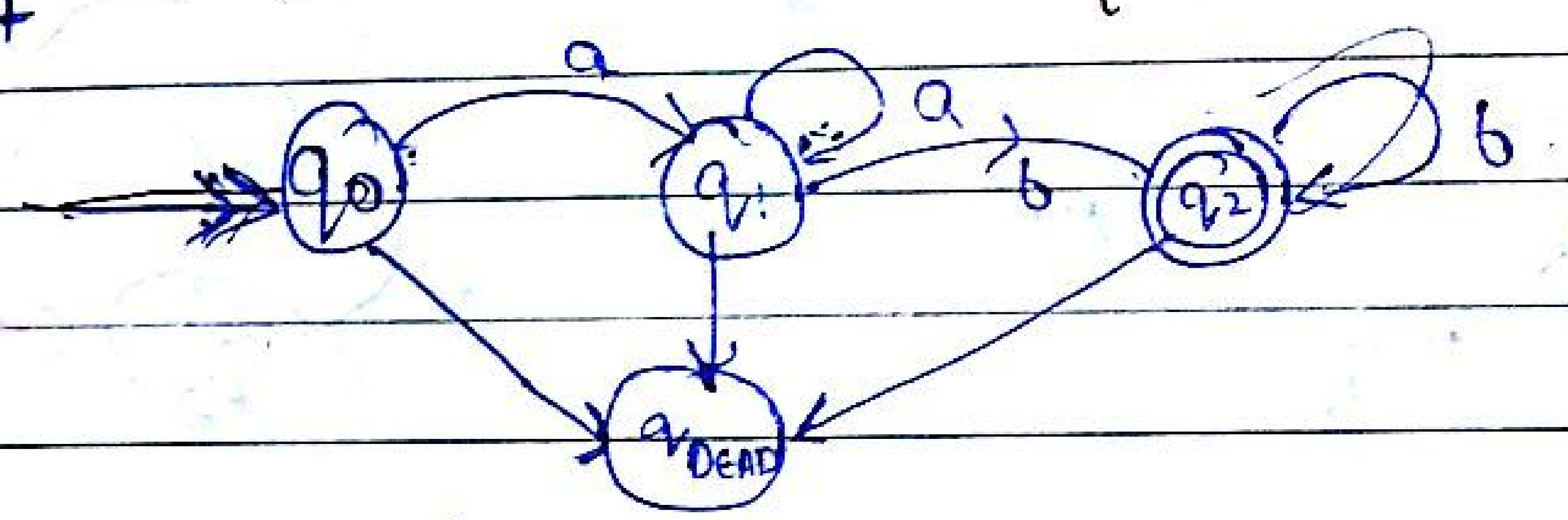


→ $a^* b^* \longrightarrow 0^* 1^*$



→ $a^n b^n, \; n>0$ $\quad \Sigma^* = \{a, b\}$ $\quad \Sigma^+, \Sigma^* \to 0$ included occurrence

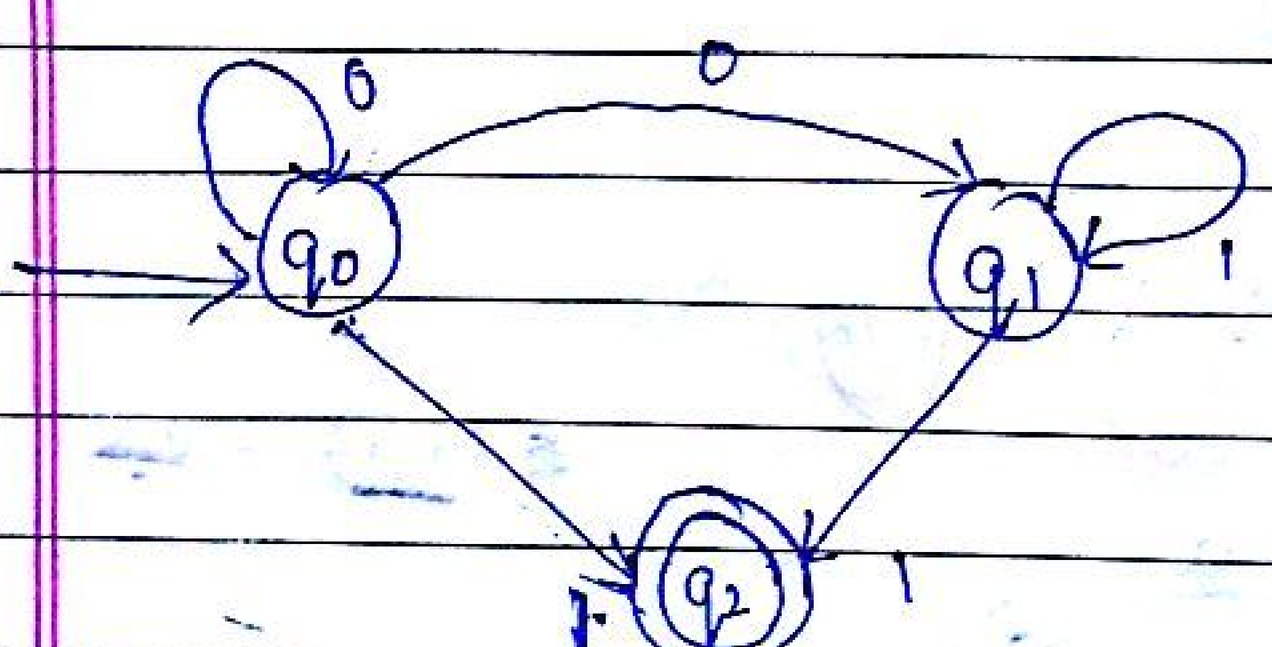
Σ^+



a-b

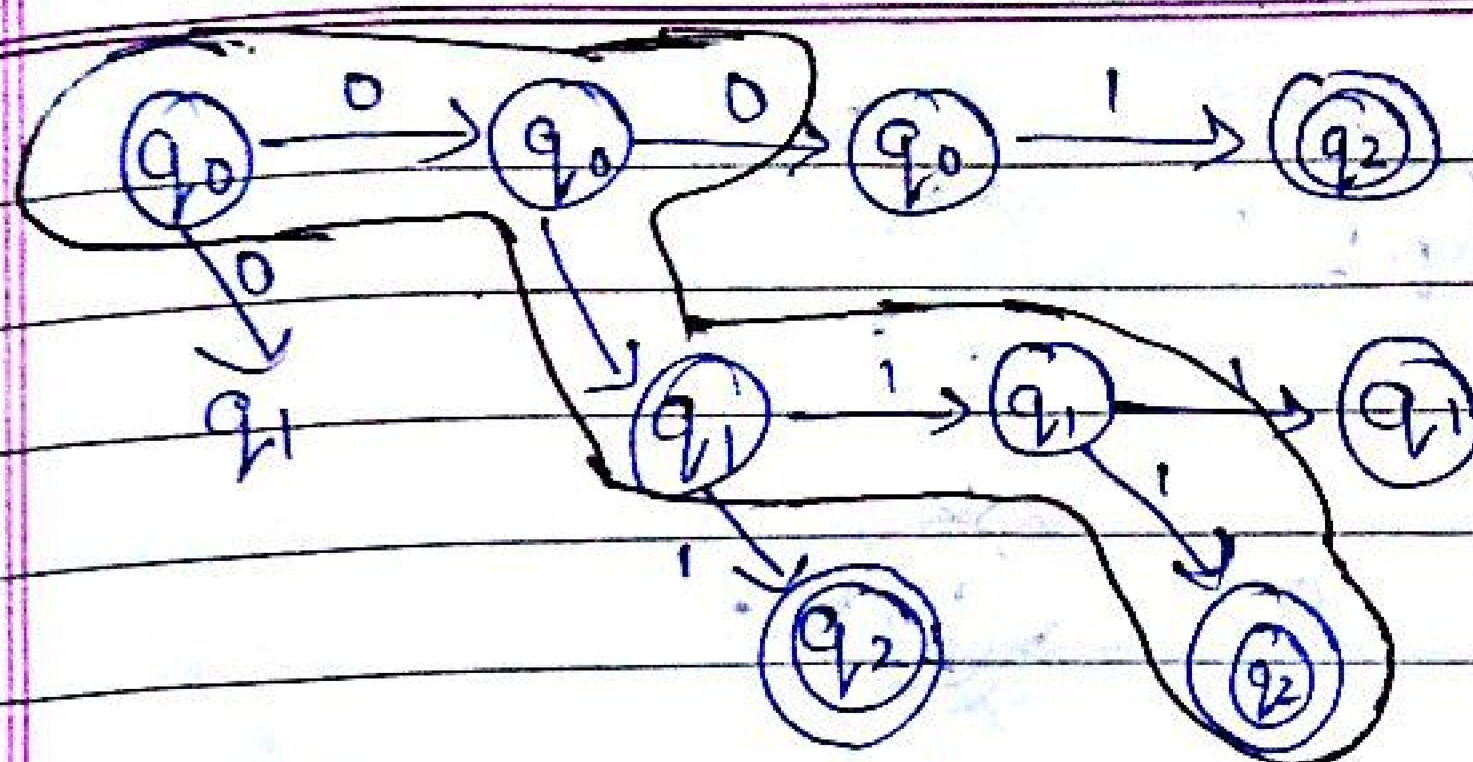
$\delta(q_0, a^n b^n) \to q_2$

NFSM (Non Deterministic finite State Machine):



Transition Table:

State	Σ: 0	1
→ q_0	$\{q_0, q_1\}$	$\{q_1, q_2\}$
q_1	ϕ	$\{q_1, q_2\}$
q_2	ϕ	ϕ



0011

Some moves of the machine cannot be determine uniquely by the input symbol ~~and~~ the present state such machine are called Non Deterministic finite automation.

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

Non Deterministic machine

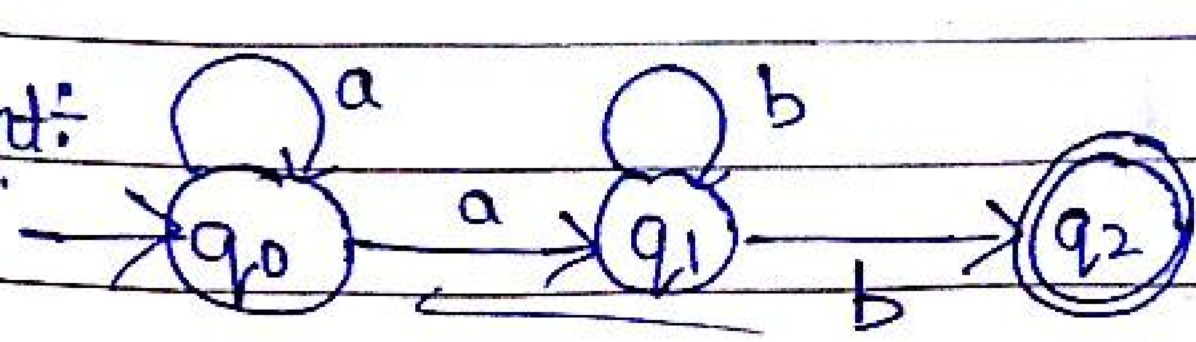
$Q \rightarrow$ set of state
$\Sigma \rightarrow$ input alphabet
$\delta \rightarrow Q \times \Sigma \rightarrow 2^Q \quad p(Q)$

$L(M) = \{w \mid w \in \Sigma^*\}$

$L(M) = \{w \mid w \in \Sigma^*, \delta(q_0, w) \rightarrow Q \cap F \neq \phi\}$

→ Difference b/w DFA & NDFA

Assignment:-

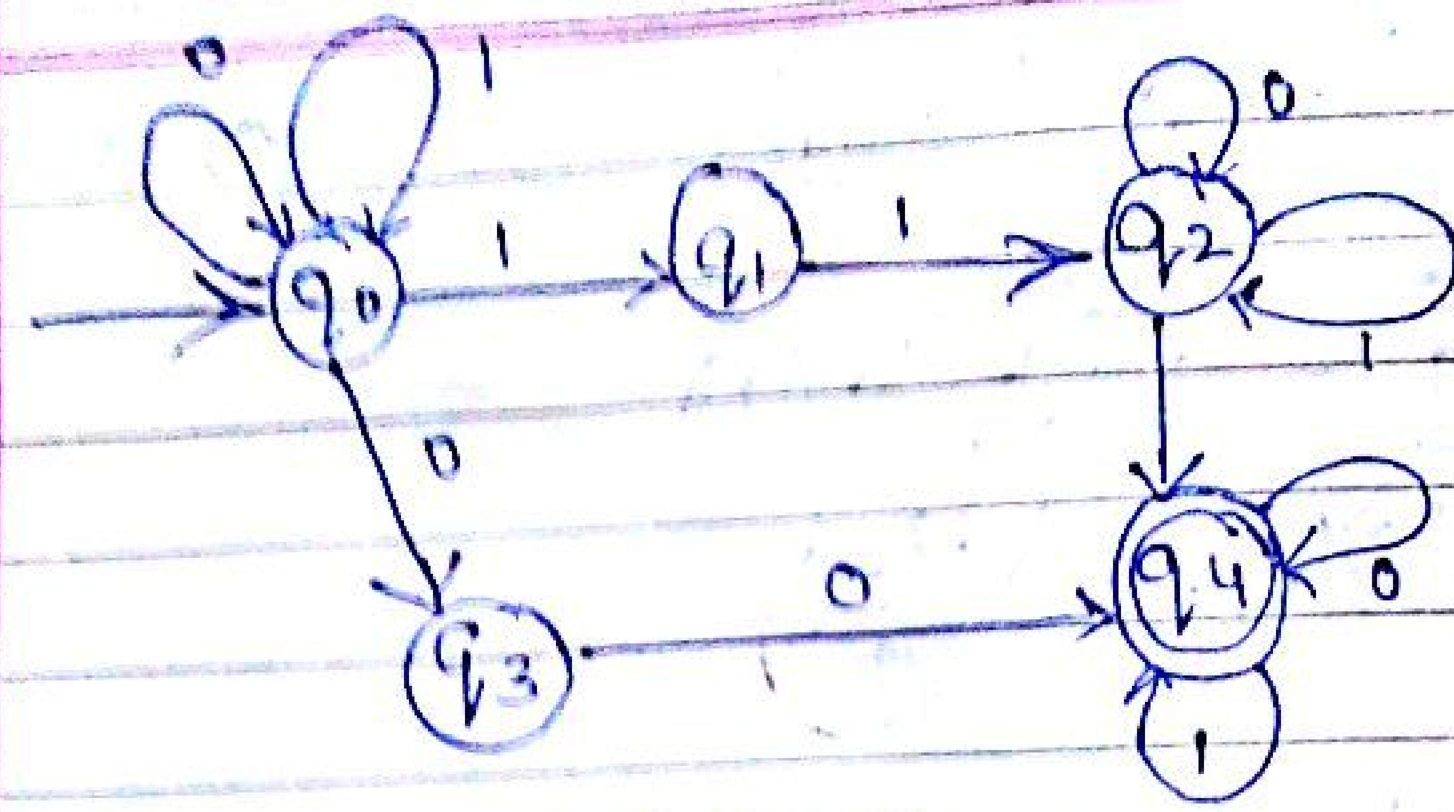


Input → aaaabb.

Date

Page

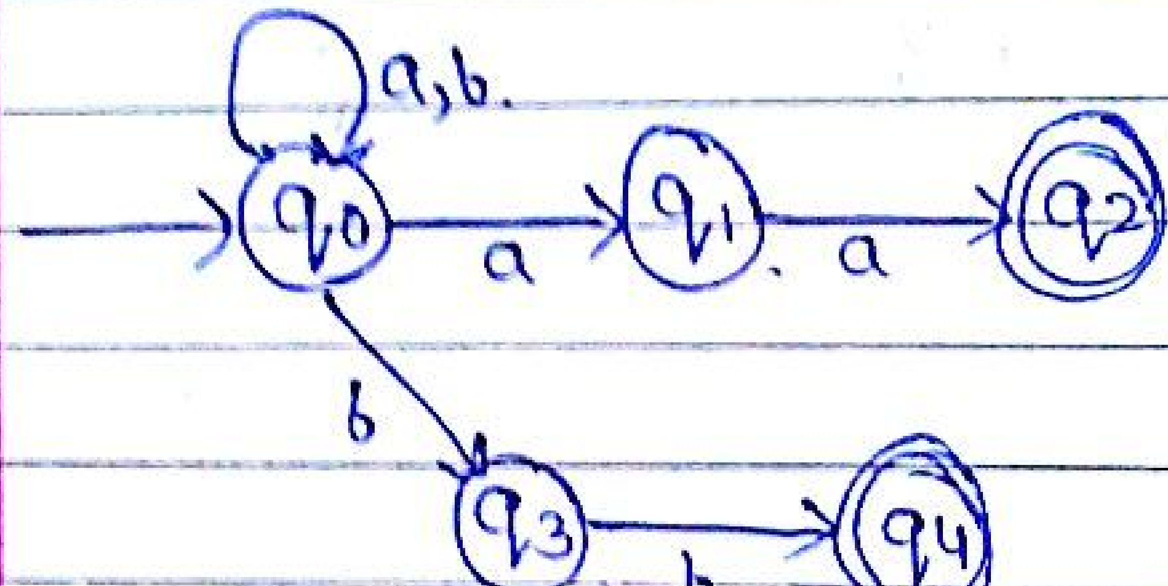
Que →



Input = 0100

$q_0 \to q_0 \to q_0 \to q_3 \to q_4$

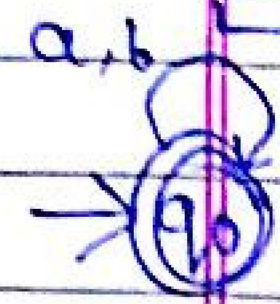
Que →

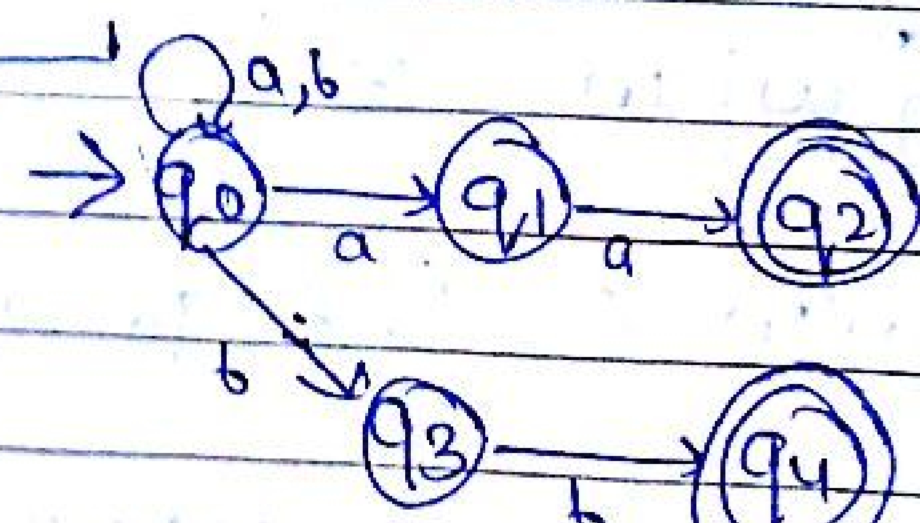


→ NDFA

$a^* bb$, $b^* aa$

→ $\underbrace{(a+b)^*}$. $(bb+aa)$

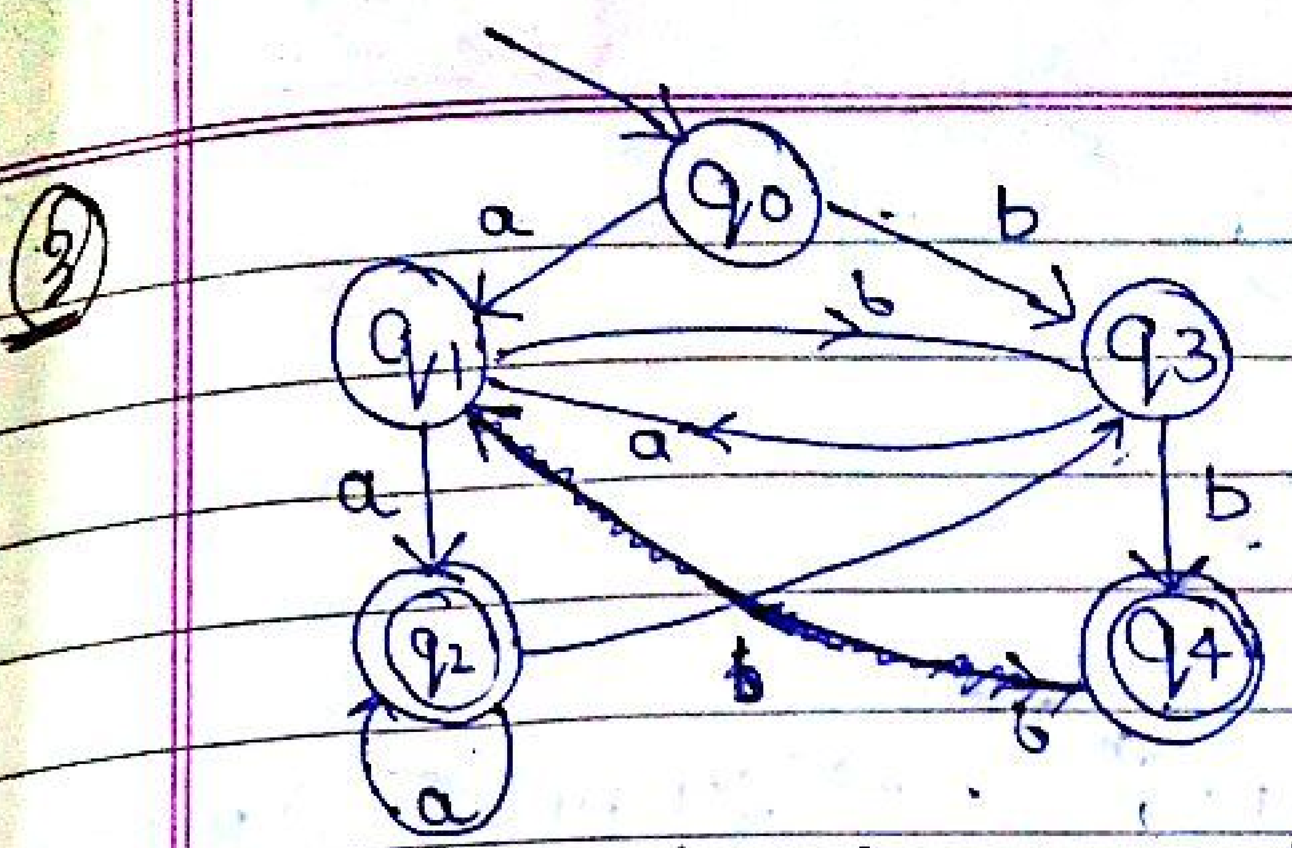




Transition table :-

State	a	b
→ 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

3



$(a+b)^* \ (aa+bb)$

aaabb
bbbaa

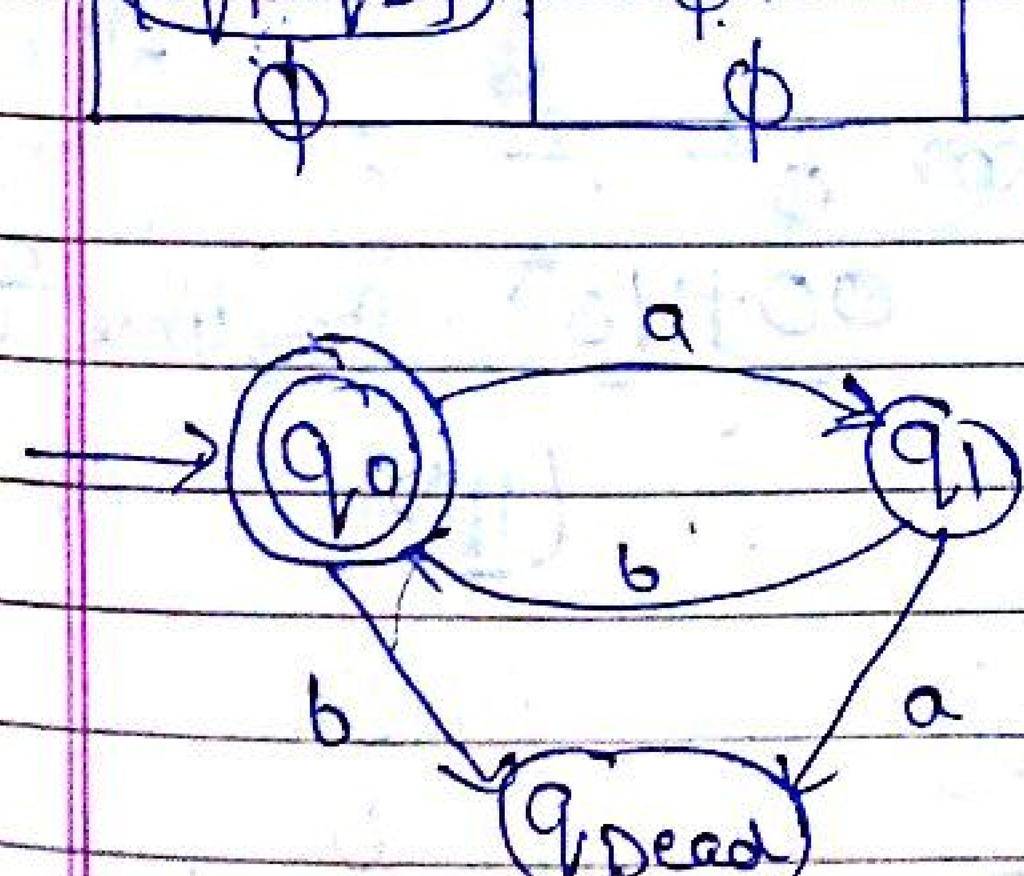
→ To Convert NDFA and DFA.

NDFA

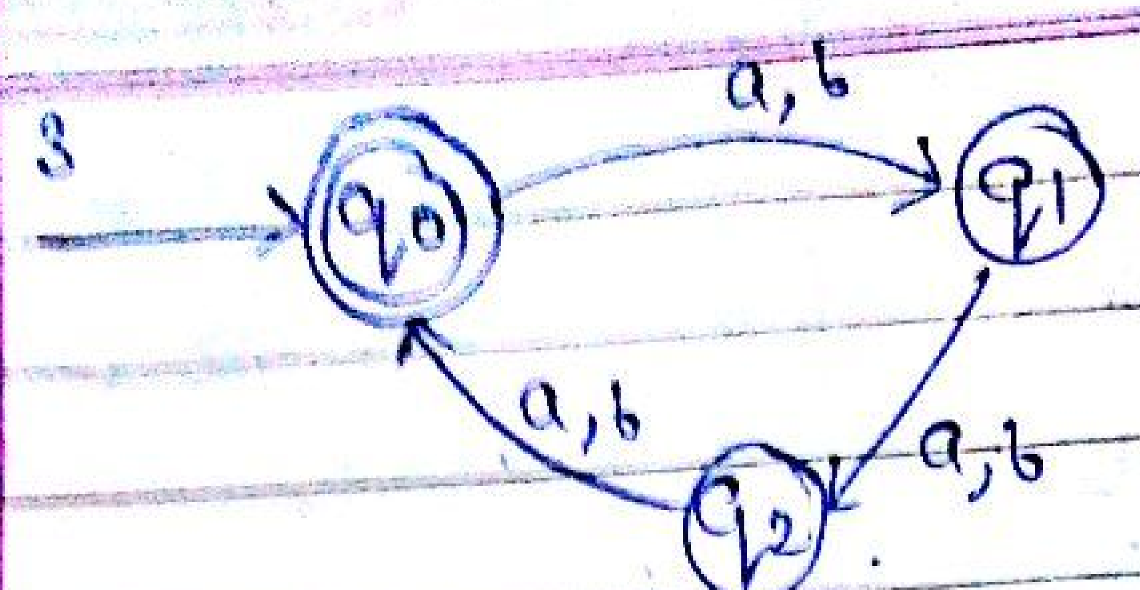
State	0	1
q_0	$\{q_0, q_1\}$	ϕ
q_1	ϕ	$\{q_1, q_2\}$
q_2	ϕ	ϕ

DFA

q_0	$[q_0\ q_1]$	ϕ
$[q_0\ q_1]$	$[q_0\ q_1]$	$[q_1, q_2]$
$[q_1\ q_2]$	ϕ	$[q_1\ q_2]$
ϕ	ϕ	ϕ



$(ab)^*$ abababab.



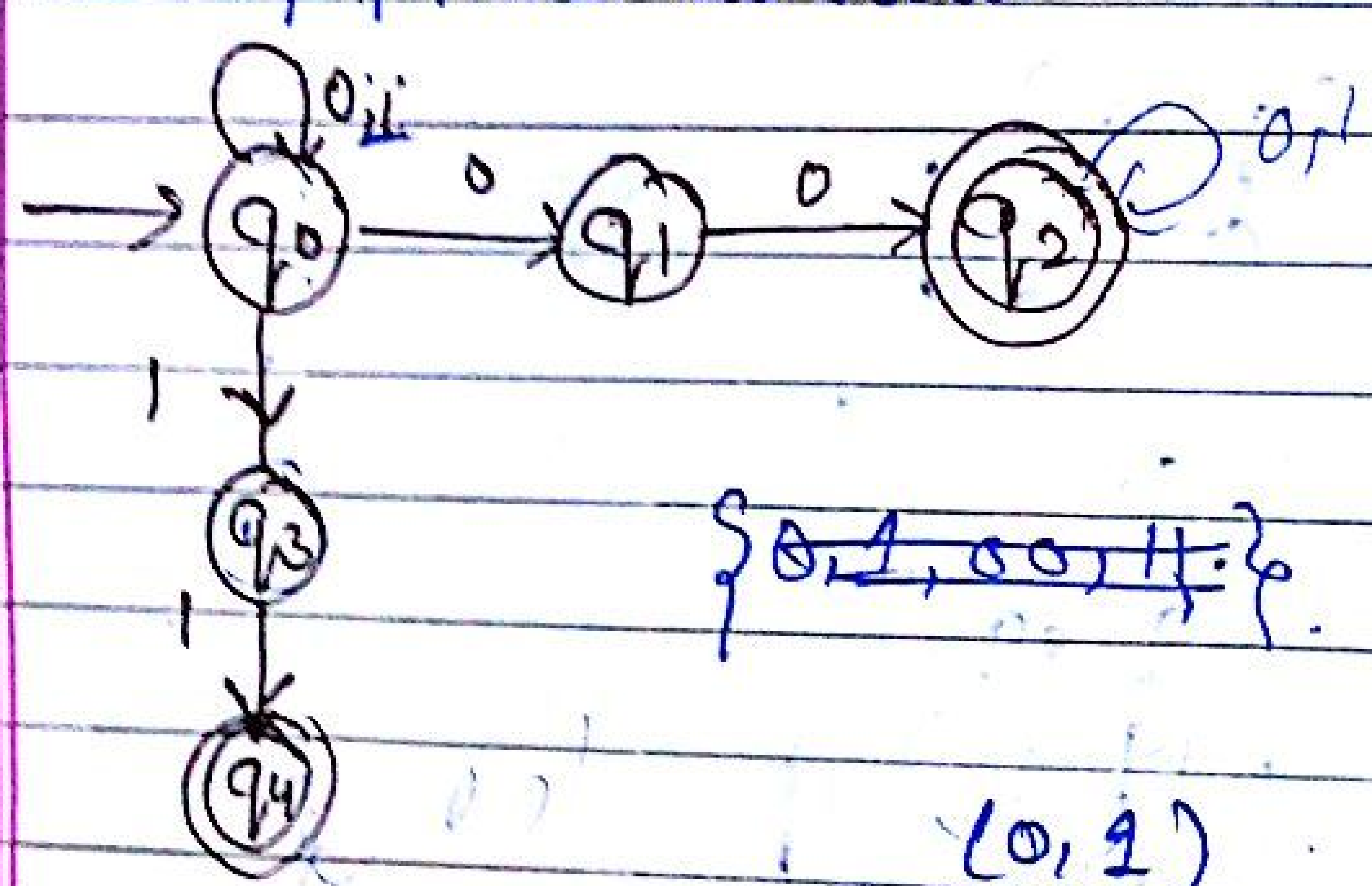
$\Sigma = \{a, b\}$

Σ^3 = aaa , $(a+b)^n$ $n * 3$ → regular Expression
bbb
abb
baa

→ NFA ↔ DFA
Transition table ↔ Regular Expression

CSE4projects.wordpress.com
→ Theory of Automata Notes

eg:



$(0+1)^* (00+11)$

~~(0+~~

{~~0, 1, 00, 11~~}

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

(0, 1)

$0^2 \ 1^2$ $\Sigma^* (0^m, 1^n$ where $m \geq 1$ $n \geq 1)$

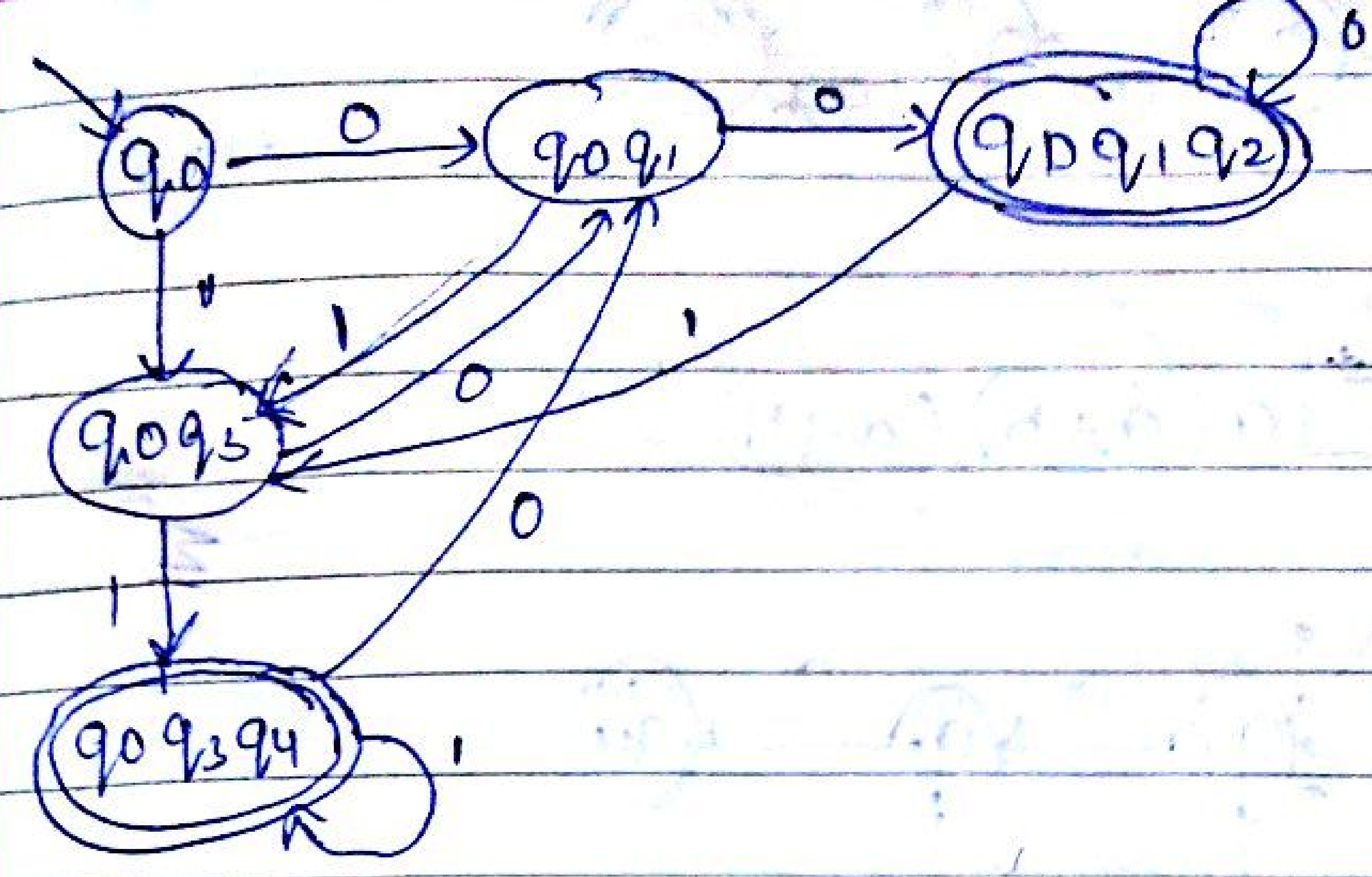
State	0	1
→ q_0	$[q_0 q_1]$	$[q_0, q_3]$
$[q_0 q_1]$	$[q_0 q_1 q_2]$	$[q_0, q_3]$
$[q_0 q_3]$	$[q_0, q_1]$	$[q_0, q_3 q_4]$
$[q_0 q_1 q_2]^*$	$[q_0 q_1 q_2]$	$[q_0 \ q_3]$
$[q_0 q_3 q_4]^*$	$[q_0, q_1]$	$[q_0, q_3, q_4]$

$00 + 110^*$ = Any time

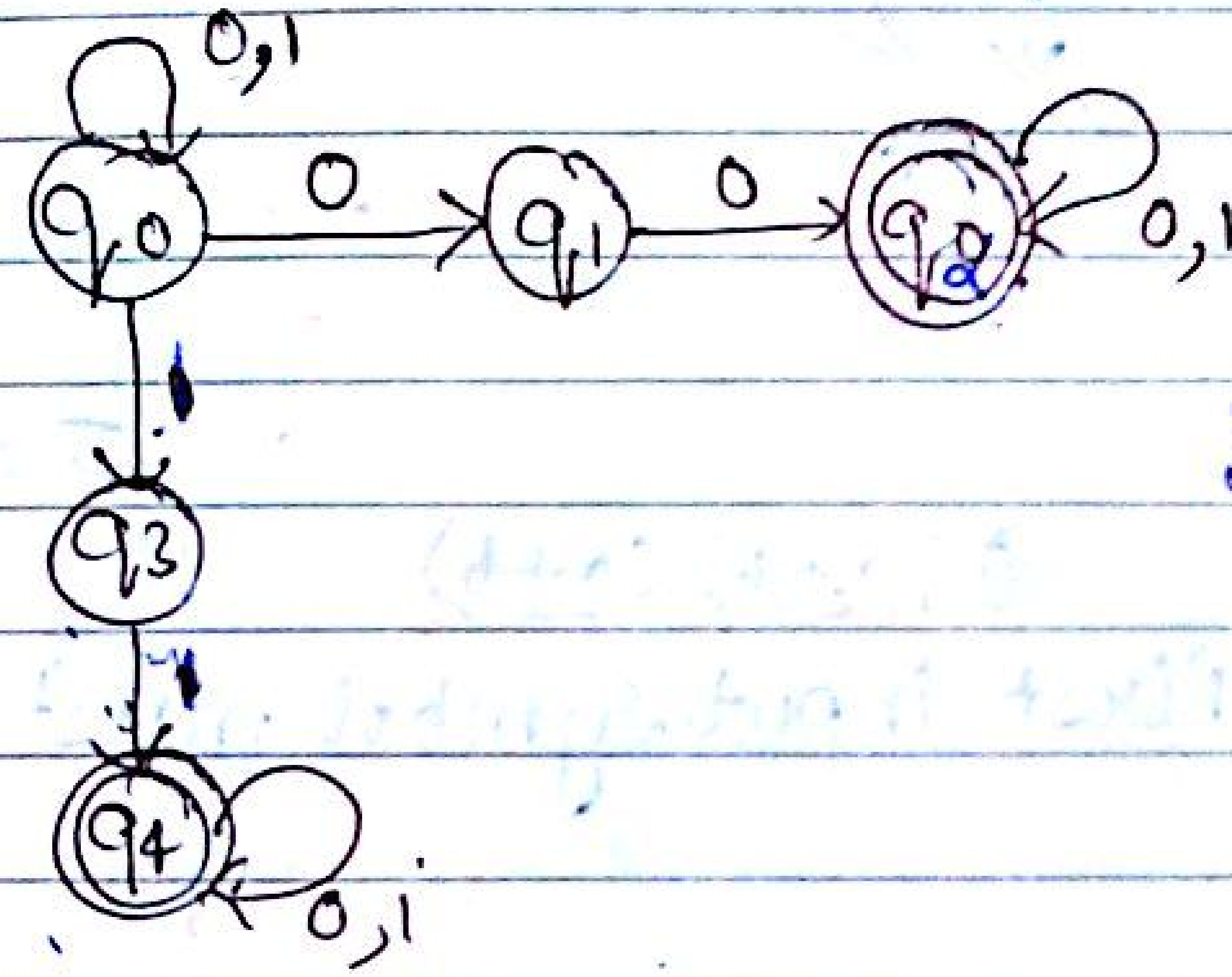
(11^*) 11 A.

00 + 11

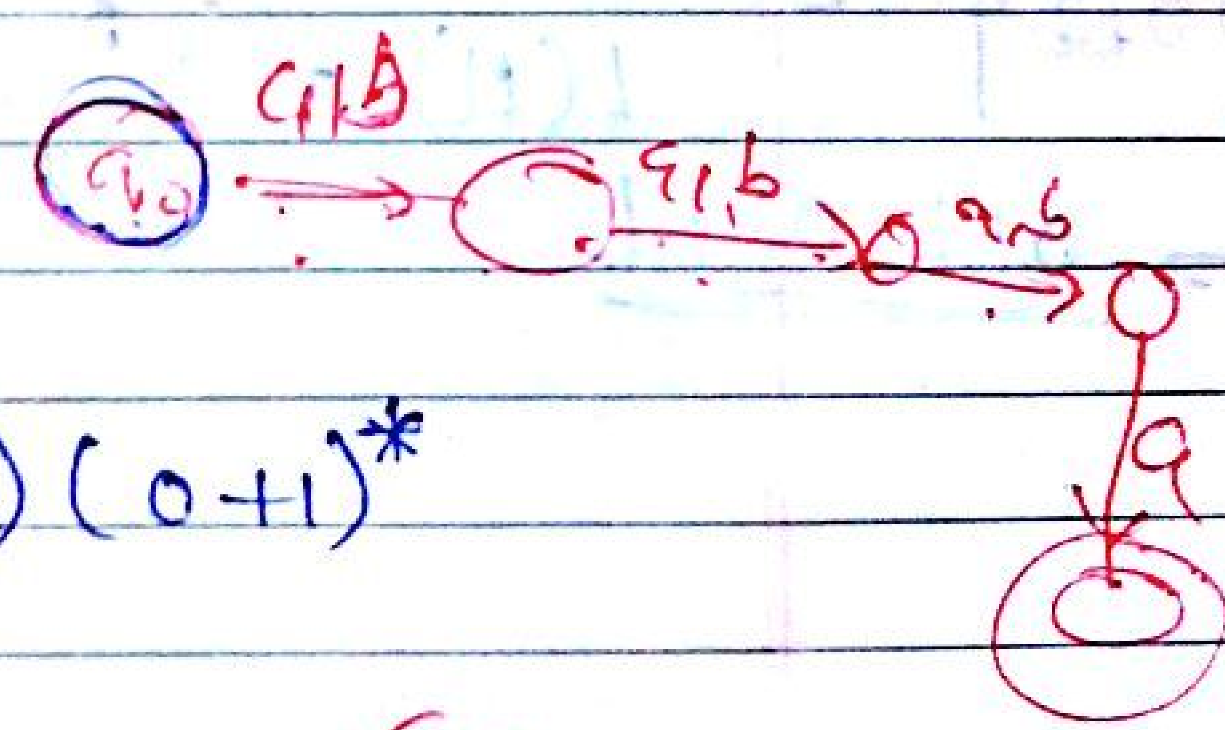
$(0^m, 1^n$ where $m \geq 1$, $n \geq 1)$



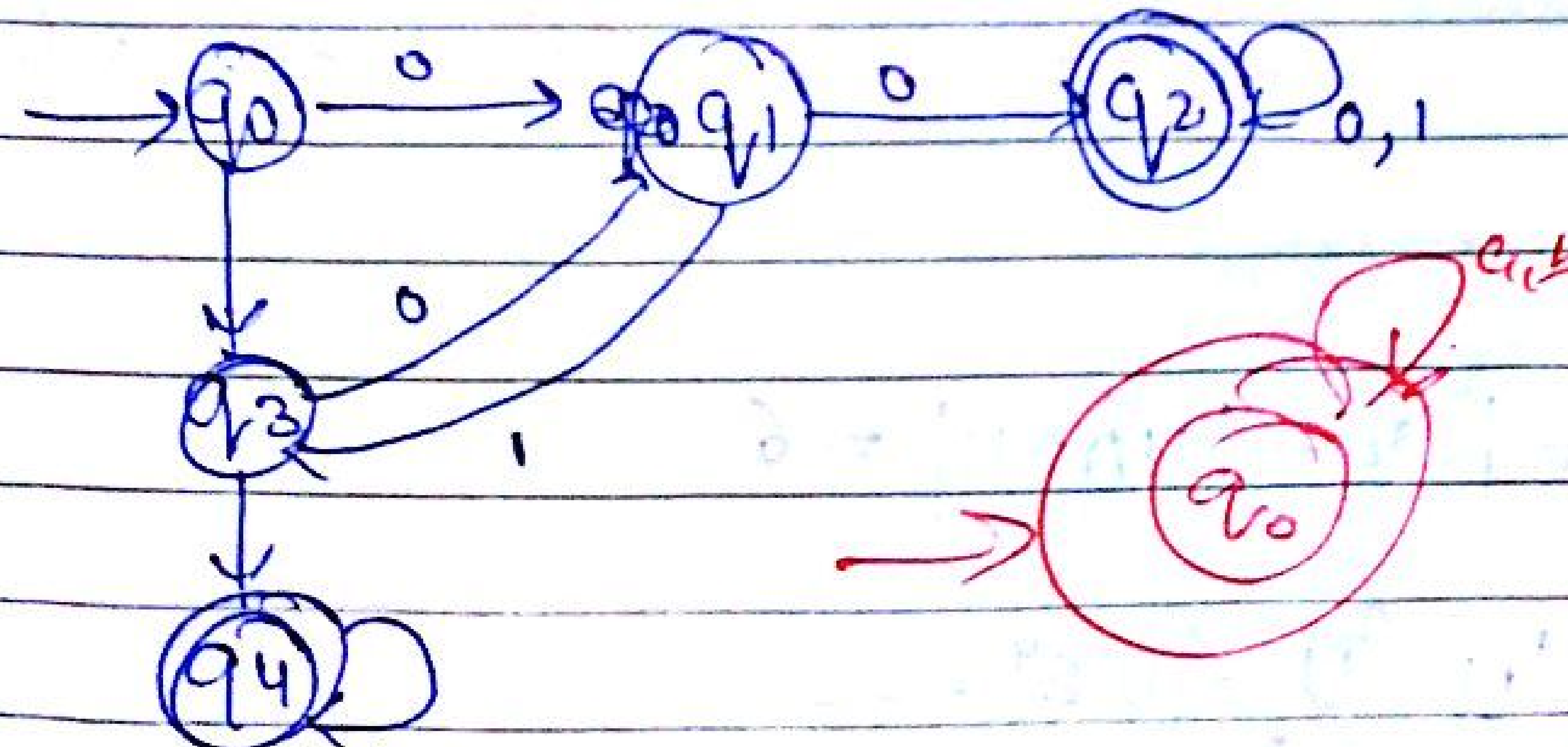
eg:



DFA or NDFA regular Expressi



Expression $(0+1)^*, (00+11)(0+1)^*$

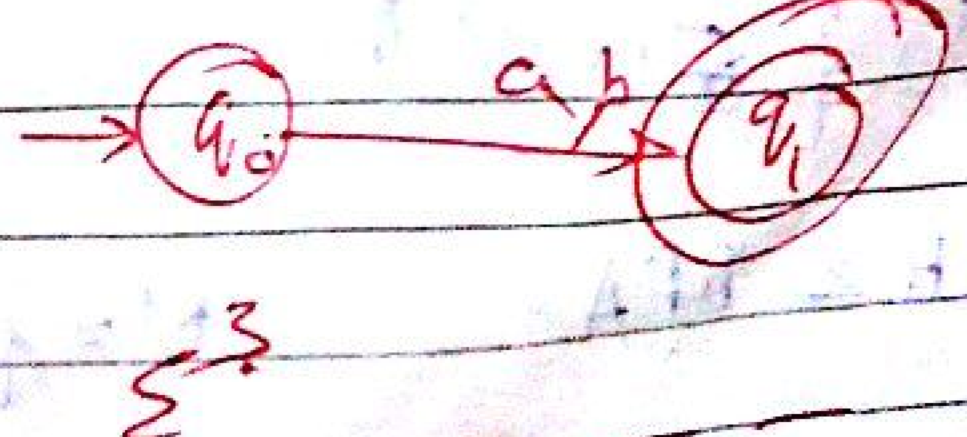


$(a+b)$

$(a+b)^*$

$(a+b)^+$

a b

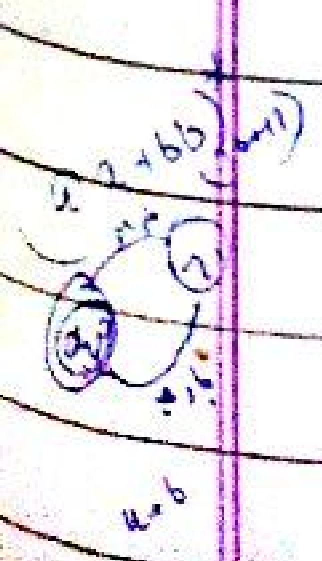


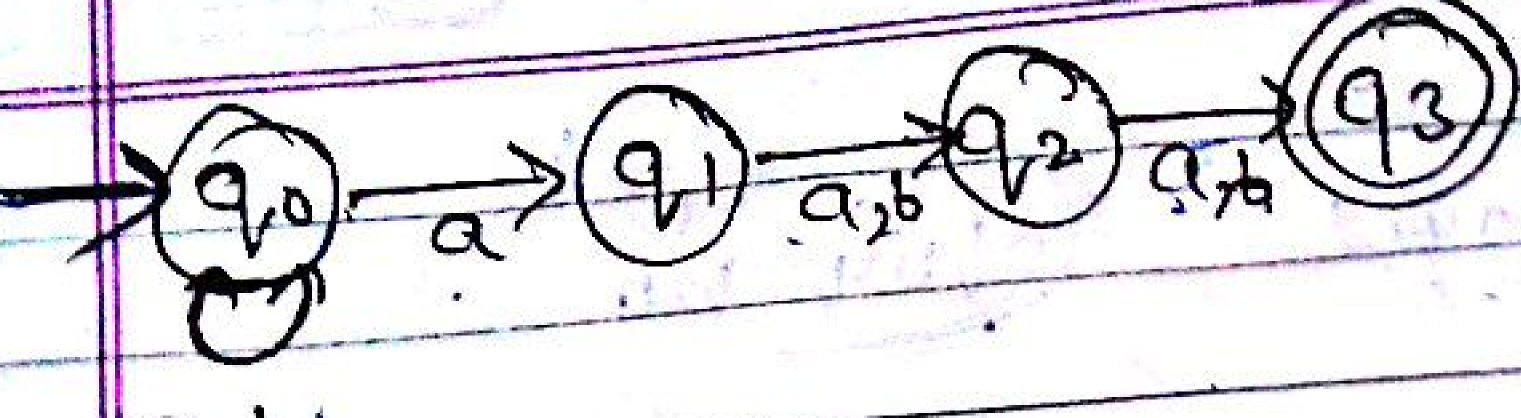
$\Sigma = \{a, b\}$

Σ^3

Σ^4

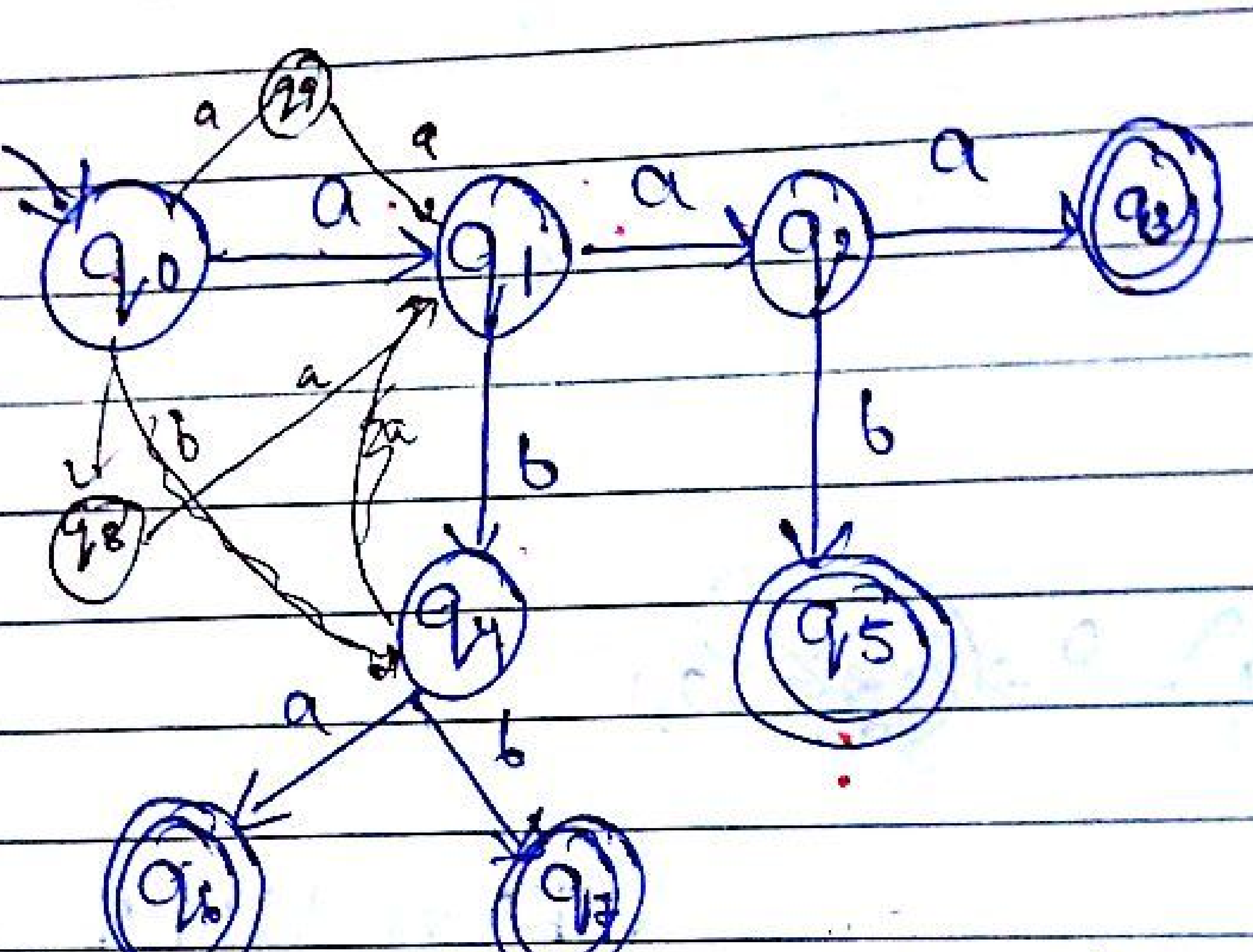
a



Eg:


$(a+b)^* a(a+b)(a+b)$ infinite

Σ^*



aaa
aab
abb

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

$a(a+b)(a+b)$ $|W| = 3.$

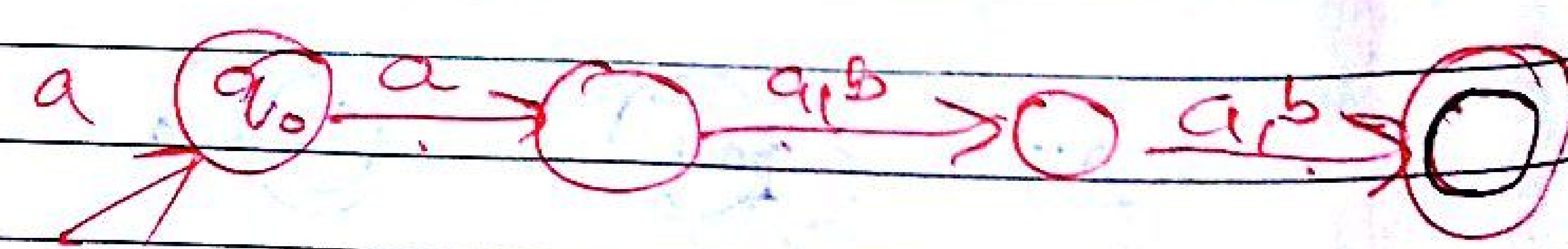
$\{0,1\} = \Sigma$

$L(M) = \Sigma^3$, first input symbol must be a

$= 01110111.$

$\Sigma = \{a,b\}$ $\Sigma^3 = \{aaa, bbb, aba,$

$\Sigma^n.$



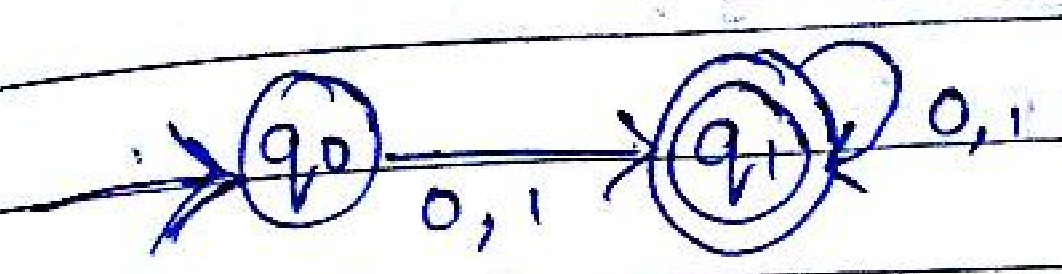
→ $110011 = |W| = |110011| = 6$

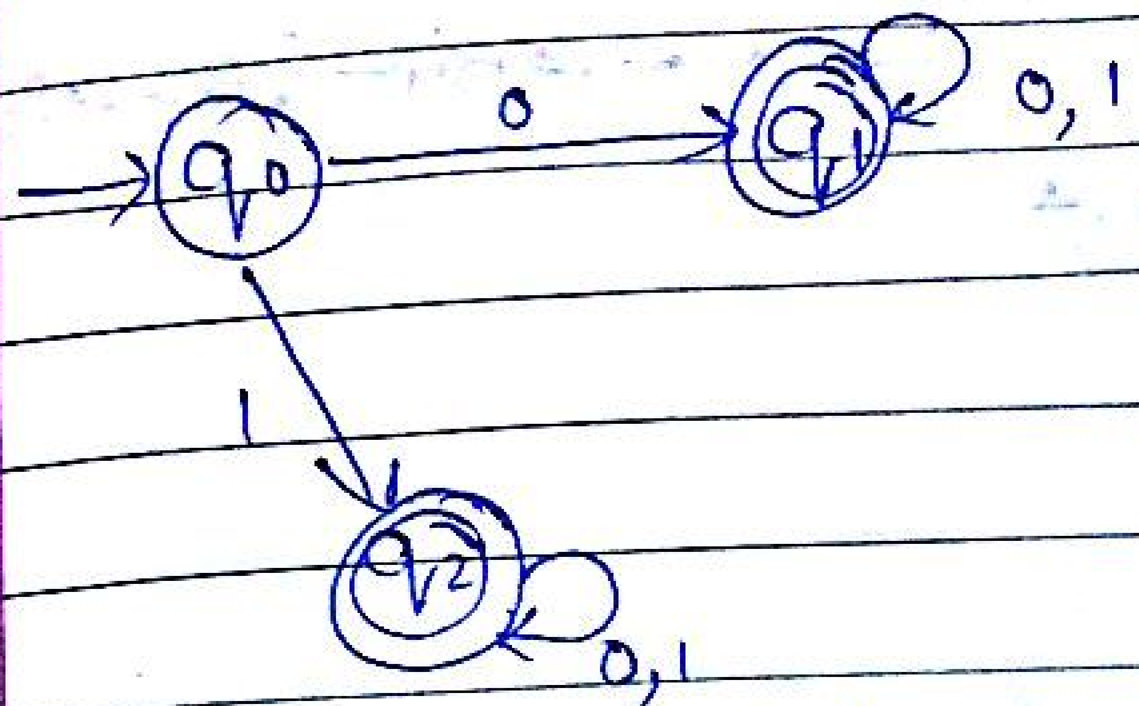
→ $\Sigma^+ \rightarrow \Sigma^1 \cup \Sigma^2 \cup \Sigma^3 \cup \Sigma^4$ ---

$\Sigma^* \{\varepsilon \cup \Sigma^+\}$

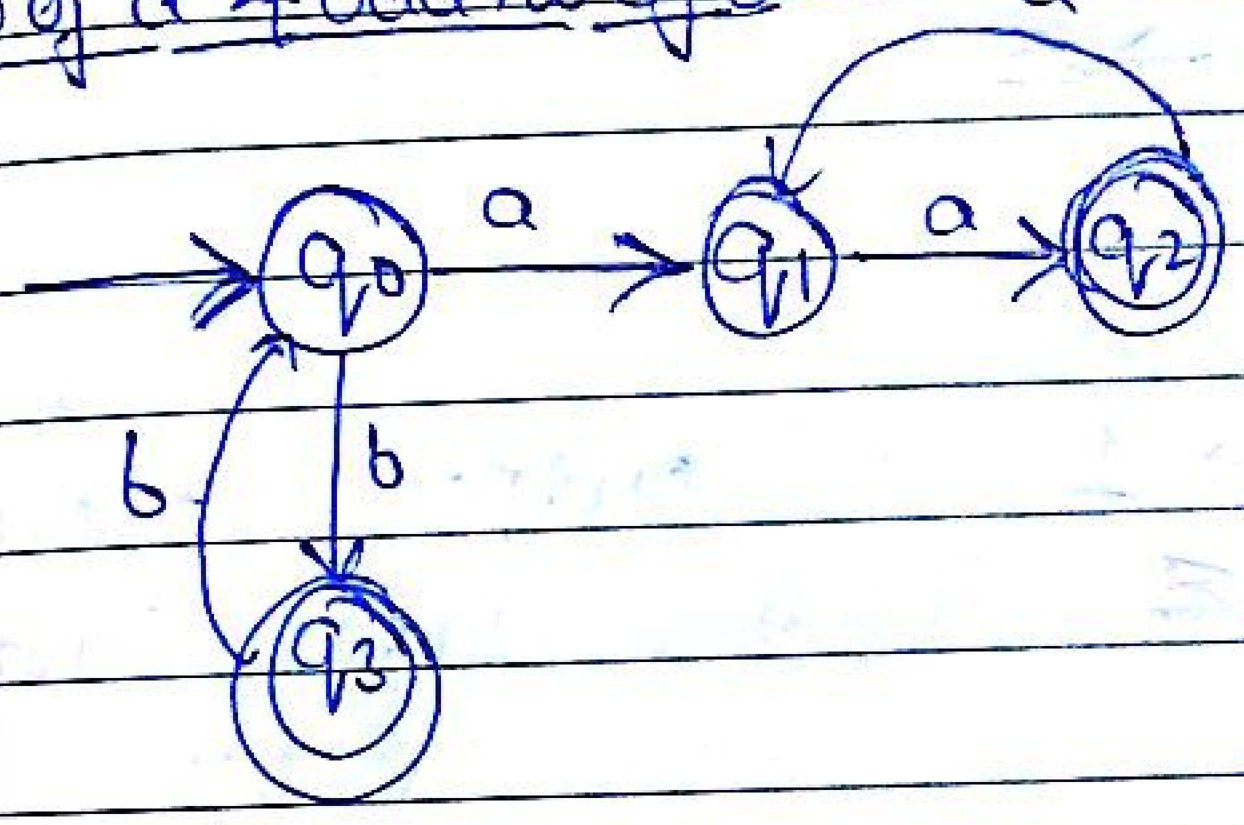
NFA & DFA. $M = \{Q, \Sigma, \delta, q_0, F\}$

$\delta = \Sigma \times Q = 2^Q.$

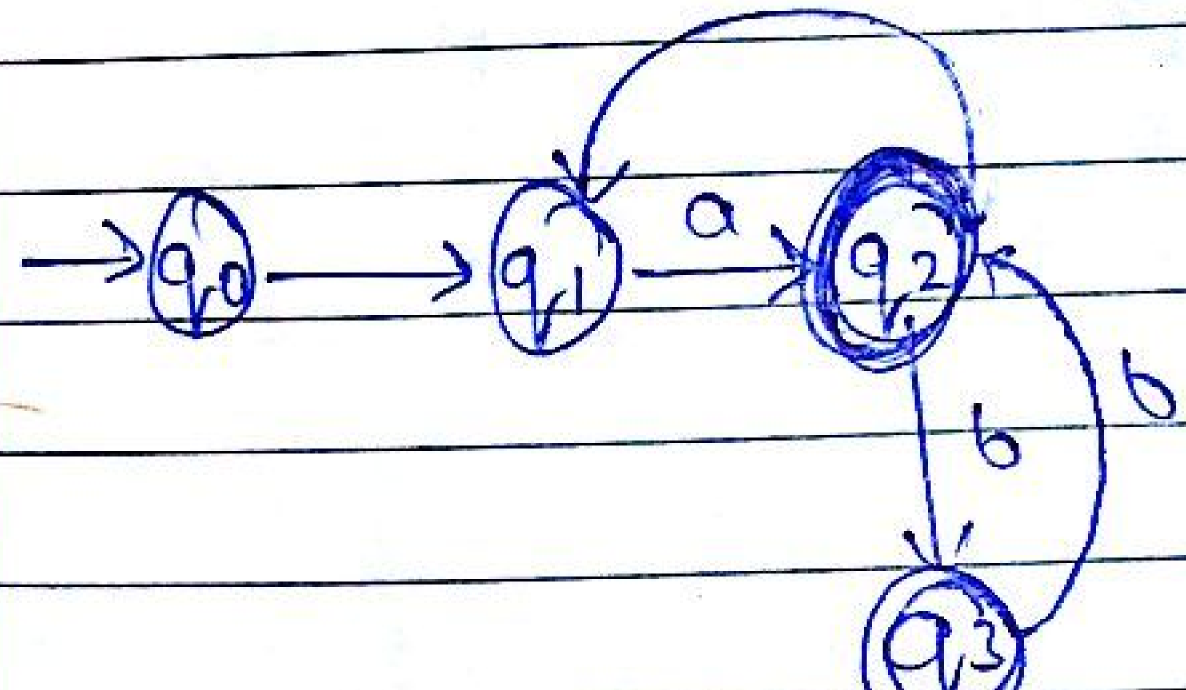




even no of a & odd no of b :-



OR



Mealy and Moore Machines :-
Automata with output
6 Tuple Machine
$M = \{\Sigma, Q, \delta, q_0, F, \lambda\}$ → output function.

	0	1	Output
q_0	q_1	q_2	1

$\lambda(q_0, 0) \rightarrow 1$
~~λ~~ $\lambda \rightarrow \Sigma \times Q \rightarrow \Sigma$

→ Moore Machine :-
$\lambda(q_0) \rightarrow 1$
$\lambda \rightarrow Q \rightarrow \Sigma$

output depent upon Current State

	0	1	output
q_0	q_1	q_2	1

→ Mealy Machine :-

	0	1
q_0	q_i	$1 \cdot q_2$

Output depent upon Input symbol & Current State

Q Draw a Moore Machine, states are q_0, q_1, q_2, q_3 Convert into Mealy Machine

	0	1	output
q_0	q_3	q_1	0
q_1	q_1	q_2	1
q_2	q_2	q_3	0
q_3	q_3	q_0	0

Sol

~~q~~	0	λ	1	λ
q_0	q_3	0	q_1	1
q_1	q_1	1	q_2	0
q_2	q_2	0	q_3	0
q_3	q_3	0	q_0	0

Mealy Machine

Que

	0		1	
	state	output	State	output
q_1	q_3	0	q_2	0
q_2	q_1	1	q_4	0
q_3	q_2	1	q_1	1
q_4	q_4	1	q_3	0

	0	1	output
q_1	q_3	q_2	0
q_3	q_2	q_1	1
q_{20}	q_1	q_4	1
q_{21}	q_1	q_4	0
q_{40}	q_4	q_3	1
q_{41}	q_4	q_4	0

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

zero ← $(0+1)^*$ $(0+1)(0+1)(0+1)$ $\Sigma = \{0,1\}$

$(0+1)^+ \rightarrow$ for length - 1, 2

→ Any string ending with two zero

$(0+1)^* \, 00$

→ String containing at least two zero.

$(0+1)^* \, 0 \, (0+1)^* \, 0 \, (0+1)^*$

→ $a^n b^m c^k$ where $\left\{ \begin{array}{l} m \geq 0 \\ n \geq 0 \\ k \geq 0. \end{array} \right\}$

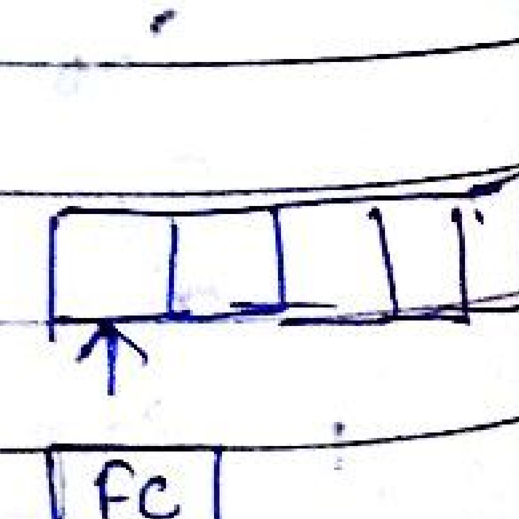
$a^* b^* c^*$

Regular Expression:

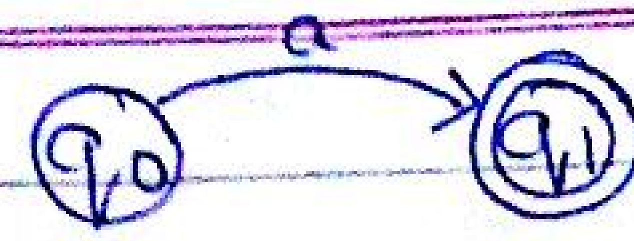
ii) Σ = $\rightarrow (q_0) \xrightarrow{\varepsilon} ((q_1))$

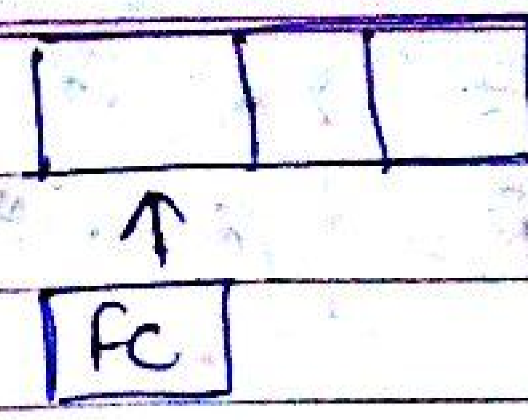
$(q_0) \xrightarrow{\wedge} (q_1)$

NDFA with Null moves or ε moves

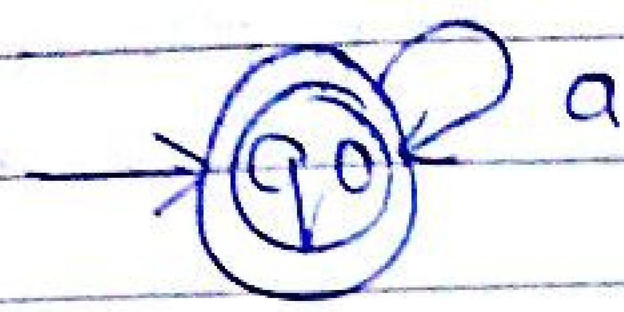


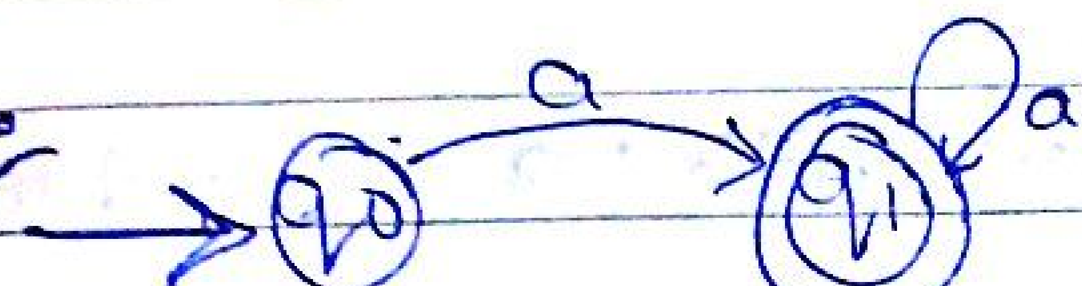
1) for $\phi \rightarrow$ (q_0) $((q_1))$

ii) for a ⇒ 



Q $\Sigma = \{a\}$
$R = a^*$

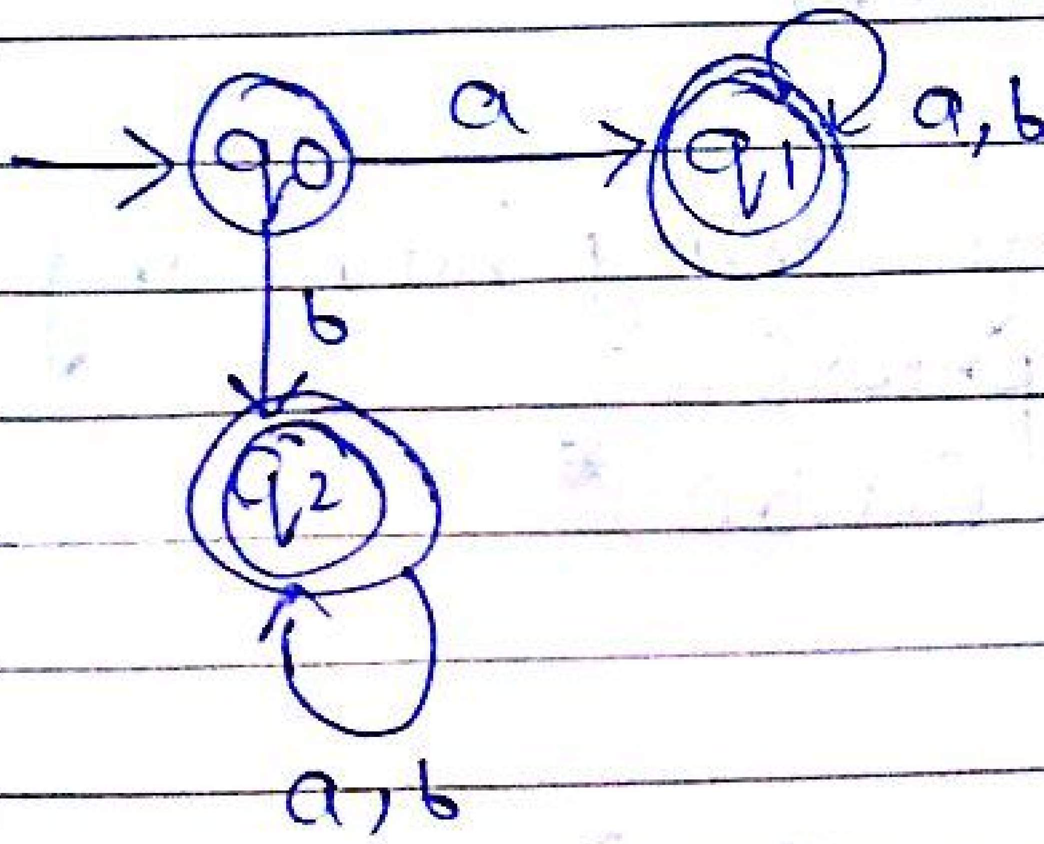
Sol 

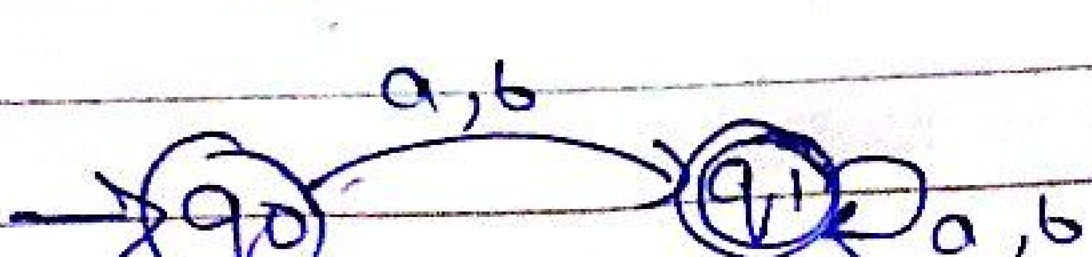
a^+ : 

Q $\Sigma = \{a, b\}$
$R = (a+b)^*$

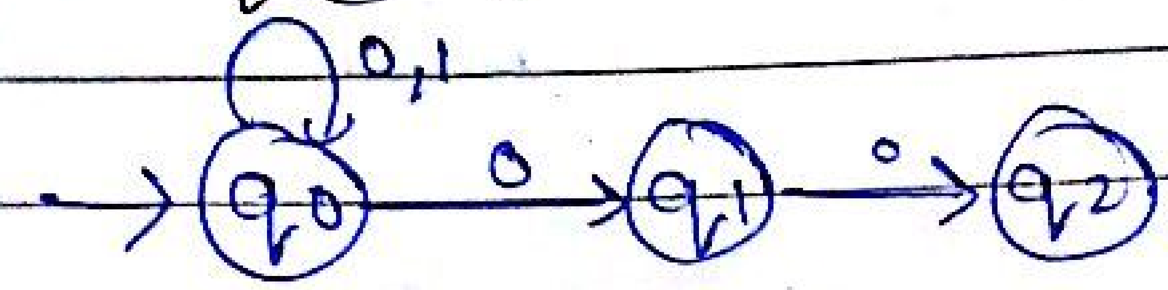
Sol 

Q $\Sigma = \{a, b\}$
$R = (a+b)^+$

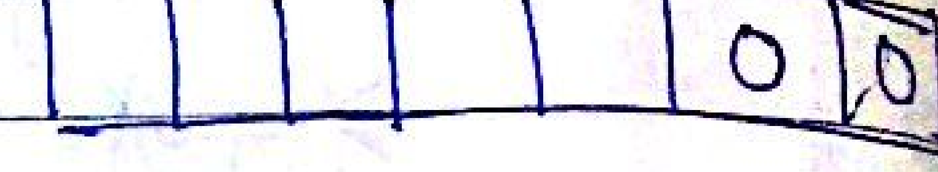
Sol 



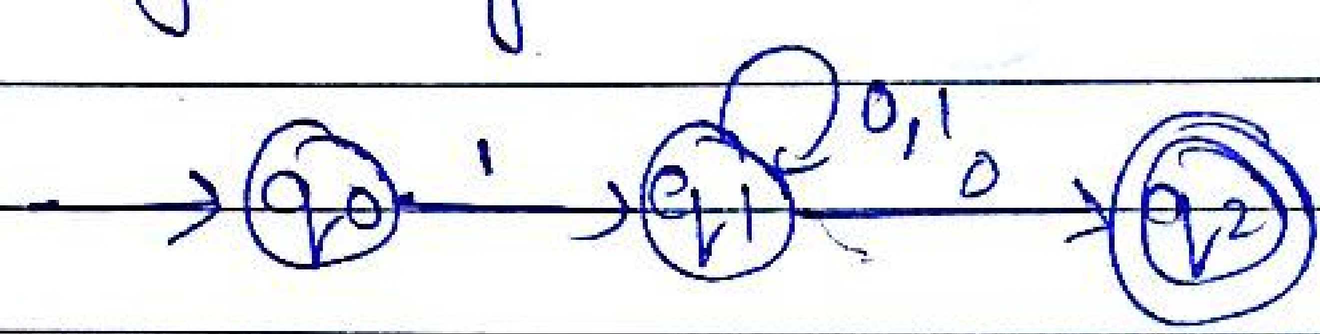
Q $\Sigma = \{0, 1\}$
$R = \{(0+1)^* 00$

Sol 

Any string ended with 00



Q $R = 1(0+1)^* 0$
Sol Any string start with 1 and end with zero.



Q $R = (a+ab)^*$ or $a^* + ab^*$
Sol Any combination of any length
All the string started with a of any length

$L = \{a, ab, aab\}$
- a, aa, aaa, aaaa, -
ab, abab, ababab ...

Q $\Sigma = \{a, b, c\}$ every string have any no a, b, c
what will be expression
Sol $a^* b^* c^*$ or $(abc)^*$

Q Make a regular expression of having string points $00 + 11$

Sol $00(0+1)^*(00+11)$

or

$11(0+1)^*(00+11)$

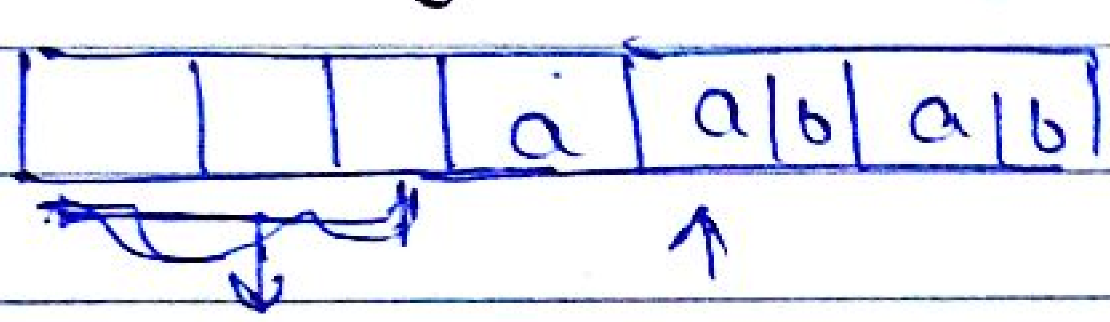
$\cancel{[00(0+1)^*] + [11(0+1)^*(00+11)^*]}$

$[00(0+1)^*(00+11)] + [11(0+1)^*(00+11)]$

$[00+11][0+1]^*(00+11)$

Q $\Sigma = \{a, b\}$ and strings are such that 3 characters from the right end is always a.

Sol



$(a+b)^*$ 3 character

$a(a+b)(a+b)$

$(a+b)^* a(a+b)(a+b)$

Q $\Sigma = \{a, b\}$ all the strings with at least 2 time b

Sol $(a+b)^* b (a+b)^* b (a+b)^*$

Q Exactly 2 times b.

Sol $(a)^* b (a)^* b (a)^*$

Q $\Sigma = \{0, 1\}$ and make string atleast one zero & ~~one + zero one~~ one 1

Sol $(0+1)^*(01+10)(0+1)^* \rightarrow$ exactly

$(0+1)^*(01+10)(0+1)^*(01+10)(0+1)^* \rightarrow$ atleast

Q Construct a regular expression which denotes a language L over alphabet Σ = 1 using even string

odd Σ (1)

$(1)(11)^*$

$(11)^*$

Sol $(00)^*$

Σ = 1 & odd no-length

$1(11)^*$

Q Σ = {a, b} & generate string where a, b are not available in this sequence like ab starting with b & then a.

Sol $b^* a^*$

Q Σ = {0,1} atleast one time 00 & 11.

~~$(a+ (0+1)^* (00+11) (0+1))^*$~~

0 00

$\underbrace{(0+1)^+}_{a} (00+11) \underbrace{(0+1)^+}_{Q}$

Q R = $(a+b)^* b$.

→ A Set of String ends with atleast one b

Q R = $(0(0+1)^*)^*$

→ any combination of 0, 1 of any length.

→ Set of String start with zero followed by any combination of 0, 1 of any length