RA2011030010024
KASHISH VERMA FLA WORKSHEETS

RA2011030010024

FLA worksheets

1 MCQ's →

$1 \rightarrow (a)$ $P(K) = m^{(K)} + 5$

$2 \rightarrow (c)$ trivial proof

$3 \rightarrow d$ $m^3 + 3m$

$4 \rightarrow d$ if not S then not H

2 MCQ's

(i) Set of all strings starting and Ending with '10' and any number of 1's in between '10'.

(2)
(ii) $L = (0+1)^* 1001 (0+1)^*$

(3) C (ii) and (iii)

(4)
(i) Regular Languages.

(5)
(C) The set of all string containing at least two 0's

3) MCQ's

1. (c) 2

2 a) n

3 a) n

4 c) 15

5 a) Increase computations

6 c) 2n

7 c) I is false and II is true

8 d) DFA is more powerful

9 a) 5

10 a) Language generating strings that contain at least one symbol repeated at least twice

4 Part A

(1) difference between DFA and NFA is that we get multiple choices in NFA. so if we have a language satisfying a DFA, it will also satisfy it's equivalent NFA

2 2^n

3 n , 2^n

4 $\delta : Q \times (\Sigma \cup \varepsilon) = P(Q)$

5(a) same final state as εNFA

5 Part A

① d All of the mentioned

2 a negation

3 9

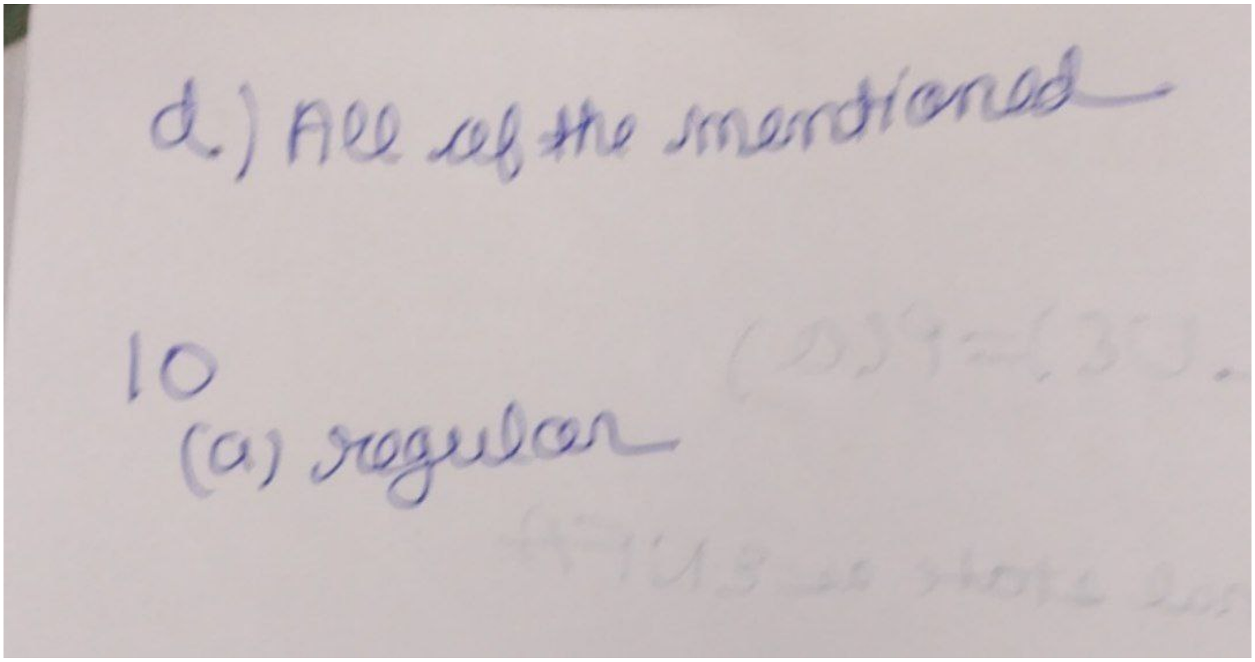
4 $\{0\} \wedge \{01\}$

5(b) $\{x \in \{0,1\} \mid x$ is all binary number with even length

6 $\cdot R^+$

7 $(0+10)^*(1+\varepsilon)$

8 $L1 \subset L2$


d.) All of the mentioned

10
(a) regular

1

1. According to principle of mathematical induction, if P(k+1) = m(k+1) + 5 is true then _____ must be true.

a) $P(k) = 3m^{(k)}$

b) $P(k) = m^{(k)} + 5$

c) $P(k) = m^{(k+2)} + 5$

d) $P(k) = m^{(k)}$

2. A proof that p → q is true based on the fact that q is true, such proofs are known as ___________

a) Direct proof
b) Contrapositive proofs
c) Trivial proof
d) Proof by cases

3. For any positive integer m ______ is divisible by 4.

a) $5m^2 + 2$

b) 3m + 1

c) $m^2 + 3$

d) $m^3 + 3m$

4. onlyhe “-if-part” of the statement of “H if and only if S” is __________.
a) if S then H
b) if not S then H.
c) if H then S
d) if not S then not H.

DESCRIPTIVE QUESTIONS

- Show that 2^{2n}-1 is divisible by 3 using the principles of mathematical induction.

① we observe $2^{2n}-1$ is divisible by 3

$P(1)$ = True

since $2^2-1=4-1=3$

3 is divisible by 3

Assume $P(n)$ is true for $n=k$

ie $P(k) = 2^{2k}-1$ is divisible by 3

ie $2^{2k}-1 = 3q$ where $q \in N$

now to prove that $P(k+1)$ is true.

we have $P(k+1): 2^{2(k+1)}-1$

$= 2^{2k} \cdot 2^2 - 1$

$= 2^{2k} \cdot 4 - 1$

$= 3 \cdot 2^{2k} + (2^{2k}-1)$

$= 3 \cdot 2^{2k} + 3q$

$= 3(2^{2k}+q) = 3m$ where $m \in N$

Thus $P(k+1)$ is true, whenever $P(k)$ is true

Hence, by it is true by PMI for all n.

- Prove that if for an integer a, a^2 is divisible by 3, then a is divisible by 3 using the proof by contradiction.

2

$a^2 = 3K$ $\quad$ a^2 div by 3

$a = (3K+1)$ or $(3K+2)$ $\quad$ a div by 3

let a^2 is div by 3 $\quad$ $a^2 = 3K$

a is div by 3 $\quad$ $a = (3K+1)$ or $(3K+2)$

$a^2 = (3K+1)^2$ or $(3K+2)^2$

$a^2 = (9K^2+6K+1)$ or $(9K^2+12K+4)$

$a^2 = 3\underbrace{(3K^2+2K)}_{c}+1$ $\quad$ $3\underbrace{(3K^2+4K+1)}_{D}+1$

$a^2 = 3c+1$ or $3d+1$

$\therefore$ a^2 is not div by 3

a is div by 3

3. We have a and b are 2 positive integers such that a>b but

we know that odd numbers are in the form of $2n+1$ and $2n+3$

where n is integer

so $a = 2n+3$, $b = 2n+1$, $n \in I$

Given $a > b$

now, According to given question

Case I.

$\frac{a+b}{2} = \frac{2n+3+2n+1}{2}$

$= \frac{4n+4}{2}$

-
- For any two integers a and b, (a+b) is odd if and only if exactly one of the integers a or b is odd. Prove the above statement.

$= 2n+2 = 2(n+1)$, put let $m = 2n+1$

$\frac{a+b}{2} = 2m \Rightarrow$ even number

Case II

$\frac{a-b}{2} = \frac{2n+3-2n-1}{2}$

$\frac{2}{2} = 1 \Rightarrow$ odd number

Hence we can see that, one is odd and other is even

(Hence Proved)

5. By induction on n. As a base case, if $n=5$, then we have that

$5^2 = 25 < 32 = 2^5$ so claim holds

For the inductive step, assume that for some $n \geq 5$, that $n^2 < 2^n$

Then we have that

$(n+1)^2 = n^2 + 2n + 1$

since $n \geq 5$, we have

$(n+1)^2 = n^2 + 2n + 1 < n^2 + 2n + n$ $(1 < 5 \leq n)$

$= n^2 + 3n < n^2 + n^2$

$= 2n^2$

- Prove using mathematical induction for n>=5, 2n>n^2.

• So $(n+1)^2 < 2n^2$. Now by our inductive hypothesis, we know that $n^2 < 2^n$. This means that

$$(n+1)^2 < 2n^2$$
$$< 2(2^n) \quad \text{(Hence Proved)}$$
$$= 2^{n+1}$$

6. for $n = 1$ $\left\{ \frac{n(n+1)(2n+1)}{6} \right.$

$LHS = 1^2 = 1$

$RHS = \frac{1(1+1)(2\times1+1)}{6} = \frac{6}{6} = 1$

$LHS = RHS$

$P(n)$ is true for $n = 1$

Assume that $P(K)$ is true

$$1^2+2^2+3^2+\ldots+K^2 = \frac{K(K+1)(2K+1)}{6}$$

We will prove $P(K+1)$ is true.

$$1^2+2^2+3^2+\ldots(K+1)^2 = \frac{K(K+1)(2K+1)}{6} + (K+1)^2$$

$$= \frac{K(K+1)(2K+1)+6(K+1)^2}{6}$$

$$= \frac{(K+1)(K(2K+1)+6(K+1))}{6}$$

- Prove that the sum of n squares can be found as follows
  - $1^2+2^2+3^2+\ldots+n^2=n(n+1)(2n+1)/6$

$$= \frac{(K+1)(2K^2+K+6K+1)}{6}$$

$$= \frac{(K+1)(K+2)(2K+3)}{6}$$

Thus $1^2+2^2+3^2+\dots = \frac{(K+1)(K+2)(2K+3)}{6}$

$P(K+1)$ is true when $p(K)$ is true

$\therefore$ By principle of M I, $P(n)$ is true for n where n is a natural number.

2

1.The Regular expression101*10 is generically stated as

(i) Set of all strings starting and ending with '10' and any number of 1's in between '10'.

(ii) Set of all strings starting with '10' and ending with '10'.

(iii) Set of all strings starting with '10' and ending with '10' and '1' in between them.

(iv) Set of all strings starting with '10' and ending with '10' and '10' in between them.

2. Choose the RE for a language of any combination of 0's & 1's containing 1001 as a substring

(i) L=(01)*1001(01)*

(ii)L=(0+1)*1001(0+1)*

(iii)L=(01)*1001(0+1)*

(iv)L=(0+1)*1001(01)*

3. Which pair is equivalent regular expression?

(i) (ab)* and a*b* (ii) a(aa)* and (aa)*a (iii) a+ and a*a

a. Only (i)

b. Only (ii)

c. (ii) and (iii)

d. (i)(ii) and (iii)
4. NFA's accept
i. Regular Languages
ii. More languages than a DFA can accept
iii. Languages that are not regular
iv. Context Free Languages
5. Which one of the following languages over the alphabet {0, 1} is described by the regular expression (0 + 1) *0(0 + 1) *0(0 + 1) *?
(a) The set of all strings containing the substring 00
(b) The set of all strings containing at most two 0's
(c) The set of all strings containing at least two 0's
(d) The set of all strings starting and ending with 0 or 1

Part-B

1.Describe the Language generated by the following Regular Expression (0)*(101)*11.

Ans: Set of binary strings that begin with zero or more instances of 0s and contains zero or more instances of substring 101 and ends with 11.

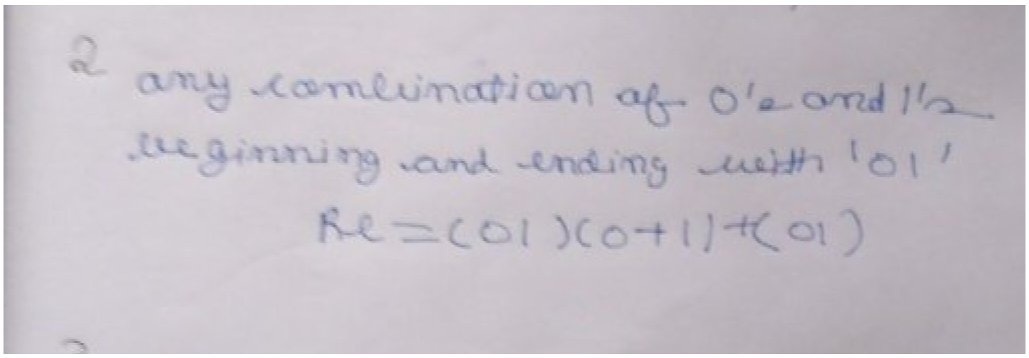
1 → language general by RE $0^{+}(101)^{*}11$
string → is any number of 0s
followed by (101) any no. of times
and ends with 11
eg. -(011) or (010110111)

2. Identify the Regular Expression for the following:

Ans: Set of binary strings that begin with zero or more instances of 0s and contains zero or more instances of substring 101 and ends with 11.

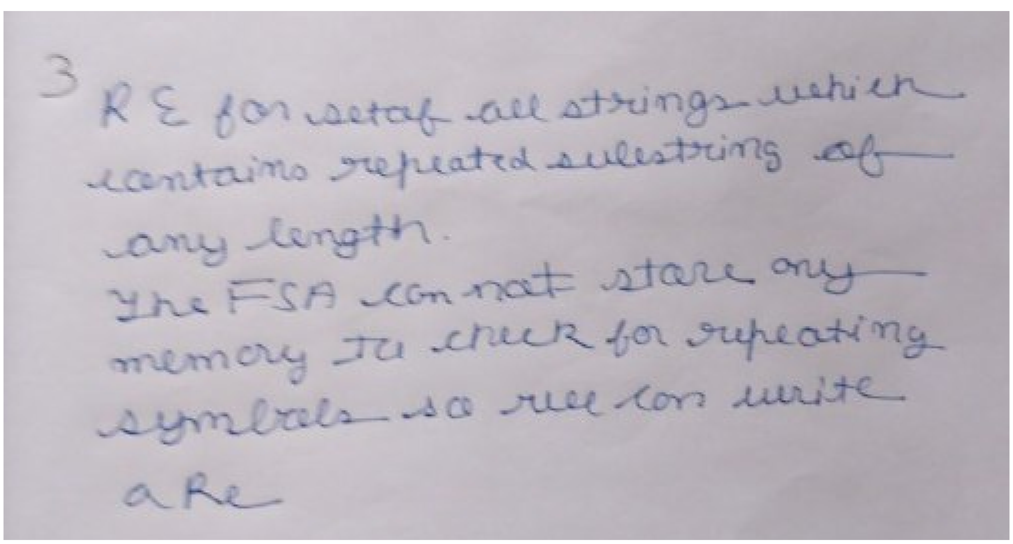
A language consists of any combination of 0’s & 1’s, beginning and ending with the string ‘01’.

Ans: Set of binary strings that begin with zero or more instances of 0s and contains zero or more instances of substring 101 and ends with 11.

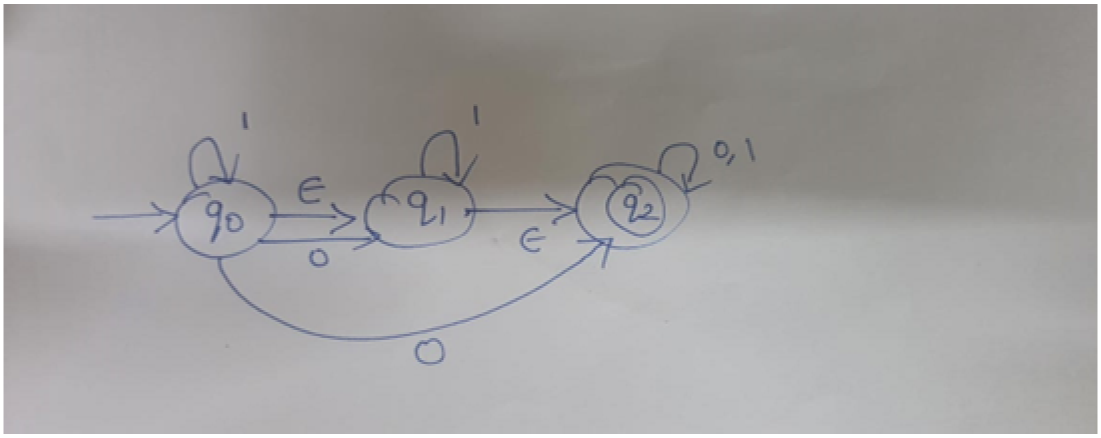

2 any combination of 0's and 1's
beginning and ending with '01'
Re=(01)(0+1)*(01)

3.Justify whether Regular expression exist for the following scenario.
Seetha wants to write the Regular expression for the set of all strings which contain repeated substrings of any length>1[E.g., “aba” Substring ‘a’ Repeats].

Yes. ([a-z])* substring ([a-z])*


3 RE for set of all strings which
contains repeated substring of
any length.
The FSA can not store any
memory to check for repeating
symbols so we can write
a Re

4.Recognize the term Epsilon (ε) – closure. Identify the Epsilon (ε) closure of the state qo in the following NFA.



4. ε closure of q_0 →

$q_0 \rightarrow q_1$ eg

ε^* of $q_0 = \{q_0, q_1\}$

5.Memorize the 5 tuple structure of DFA and NFA.

5) A deterministic finite automaton (or DFA) is a quintuple $D = (Q, \Sigma, \delta, q_0, F)$, where

- Σ is a finite input alphabet
- Q is a finite set of states
- F is a subset of Q of final (or accepting) states.
- $q_0 \in Q$ is the start state (or initial state);
- δ is the transition function, a function

$$\delta : Q \times \Sigma \rightarrow Q$$

→ A non Deterministic finite automaton (or NFA) is a quintuple $N = (Q, \Sigma, \delta, q_0, F)$ where

- Σ is a finite alphabet
- Q is a finite set of states
- F is a subset of Q of final (or accepting) states.
- $q_0 \in Q$ is the start state (or initial state)
- δ is the transition function, a function

$$\delta : Q \times (\Sigma \cup \{\varepsilon\}) \rightarrow 2^Q$$

UNIT-1

Worksheet-3

Construction of DFA, NFA, ε-NFA and equivalence of NFA and DFA

1. What is the minimum number of states to recognise the language L={w/w ϵ (0+1+2)+}?
   a) 1 **b) 2** c) 3 d) 4
2. What is the minimum number of states required by the DFA that accepts the language? L={a | a is a number divisible by n} ?
   a) n b) n+1 c) n-1 d) 2^n
3. ________ is the maximum number of states that an ε-NFA can have on ε moves.
   a) n
   b) 0
   c) Infinite
   d) 1

4. The FSA to recognize the words "infrared" and "infrastructure" has _____ number of states.

   a) 20
   b) 22
   c) 15
   d) 17

5. NFA with ϵ transitions ________

a) **Increases computations**

b) Decreases computations

c) Decreases number of states

d) Increases uncertainty

6. What are the maximum number of output states for any input state (n) in a NFA?

a) n

b) n+1

c) **2n**

d) n-1

7. I: DFA's can be constructed for all the languages

II: The strings accepted by DFA will be accepted by NFA

What can be said about these two statements?

a) Only II is false

b) Only I is false

c) **I is false and II is true**

d) II is true and I is false

8. What can be told about the recognising capability of NFA, ε-NFA and DFA?

a) All three are equally powerful

b) ε-NFA is more powerful and flexible

c) ε-NFA is less powerful and flexible

d) **DFA is more powerful**

9. What is the minimum number of states for NFA that accepts the language {01n 01 | n >=0}?

a) **5**

b) 4

c) 6

d) 16

10. Which of the given languages are accepted by Non Deterministic PDA but not by Deterministic PDA?

a) **Language generating strings that contain at least one symbol repeated at least twice**

b) Even Palindromes

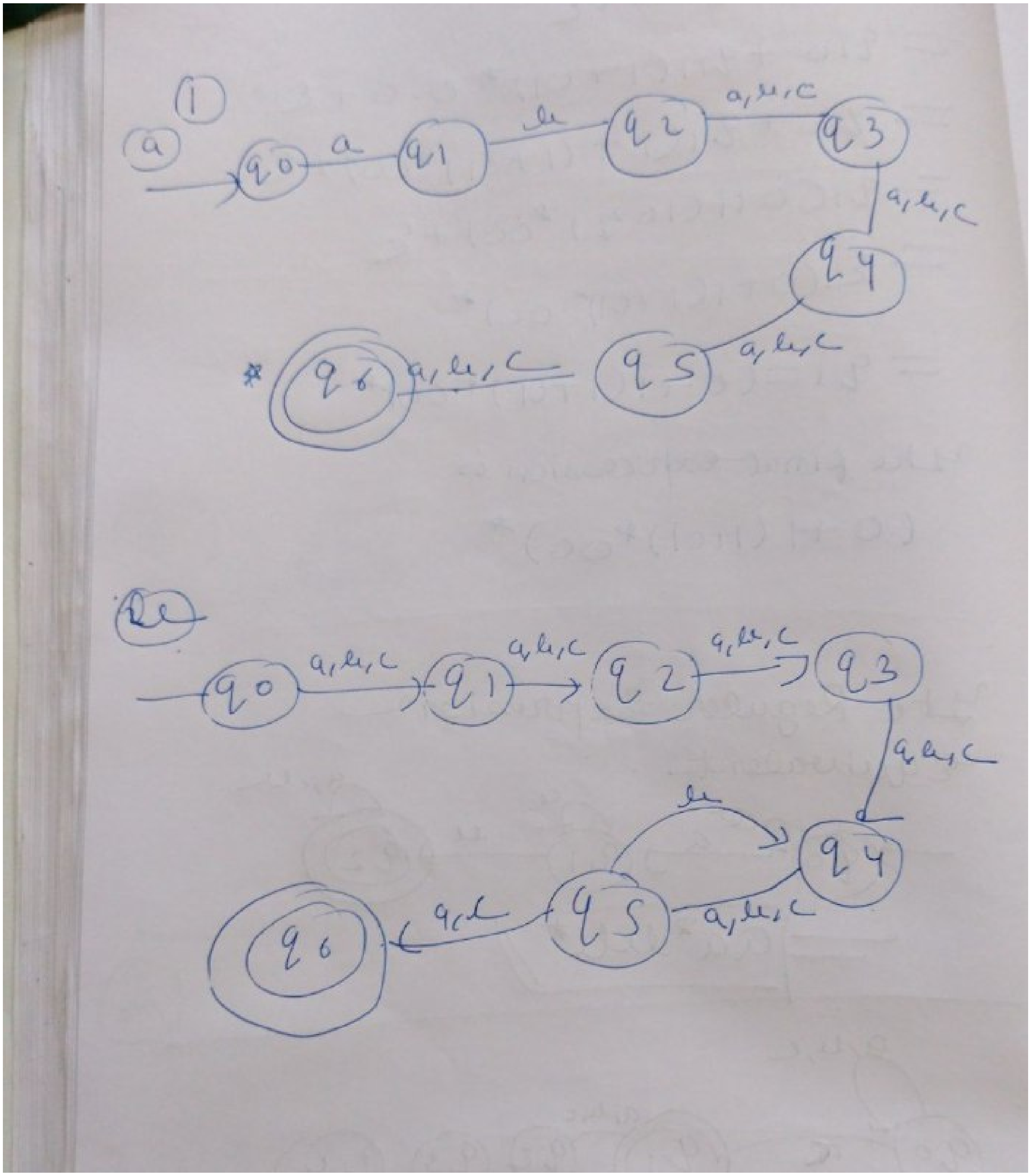
c) Strings ending with a particular symbol

d) Strings starting with particular symbol

PART-B

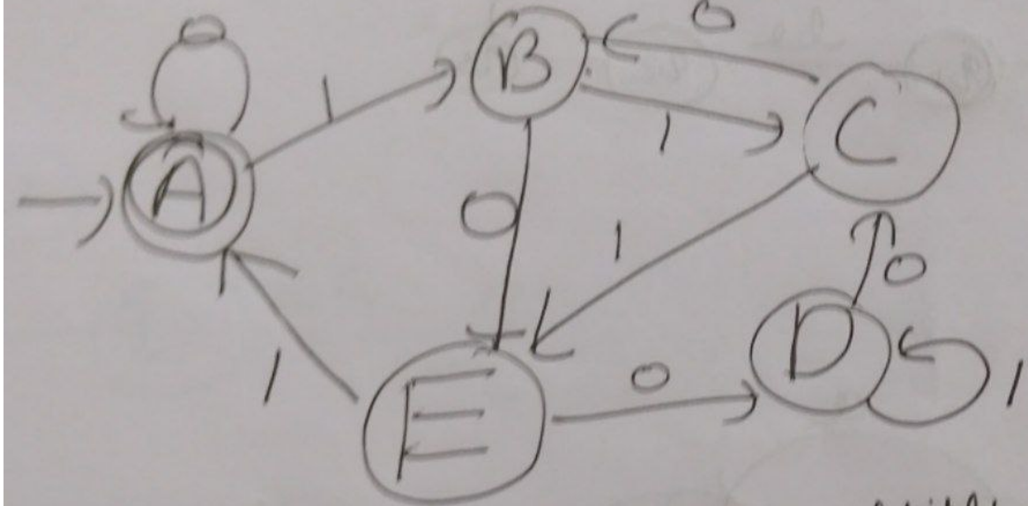
1. Construct a DFA that can recognise the six-symbol password over the input Σ={a, b, c} with the following conditions:
   a) Password should start with 'ab'

b) Password should not end with ‘bb’.



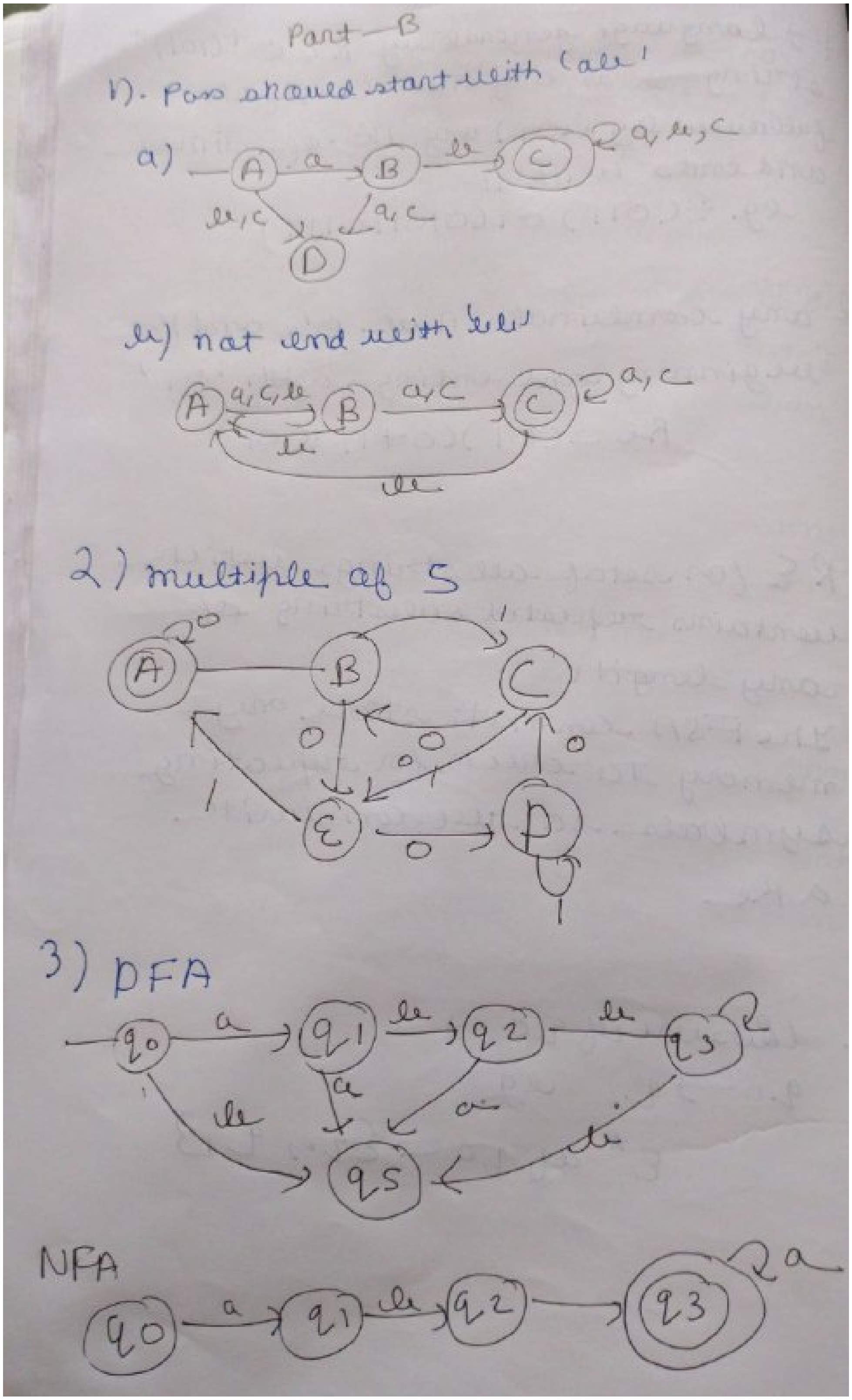
2. Construct a DFA that accepts the numbers that are multiples of five in its binary form.

(2)

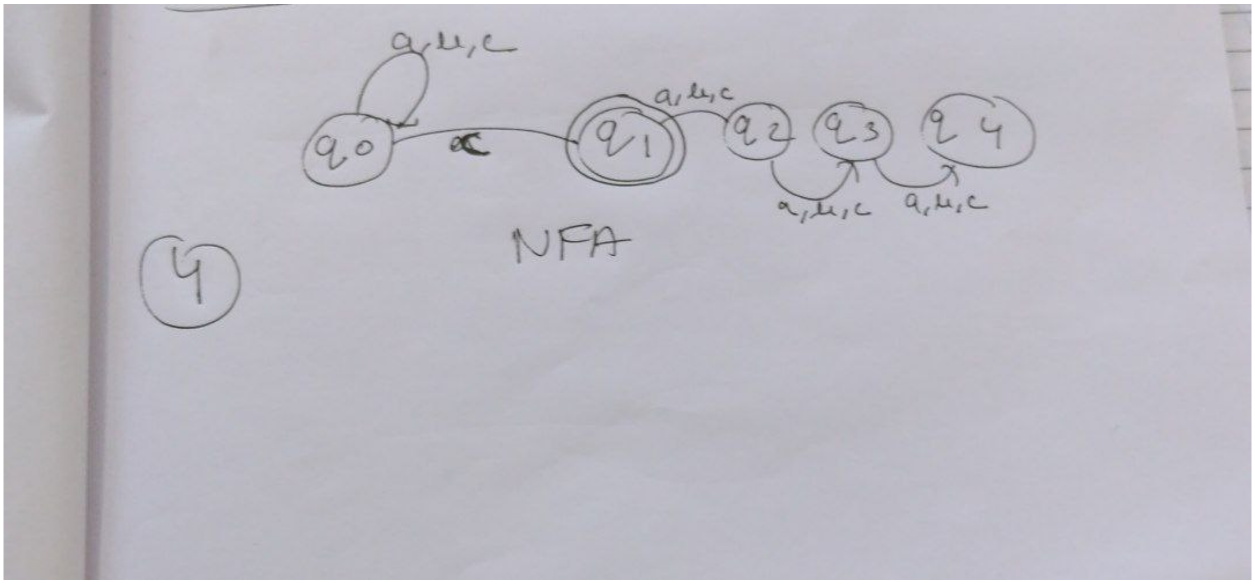


DFA that accepts multiple of 5

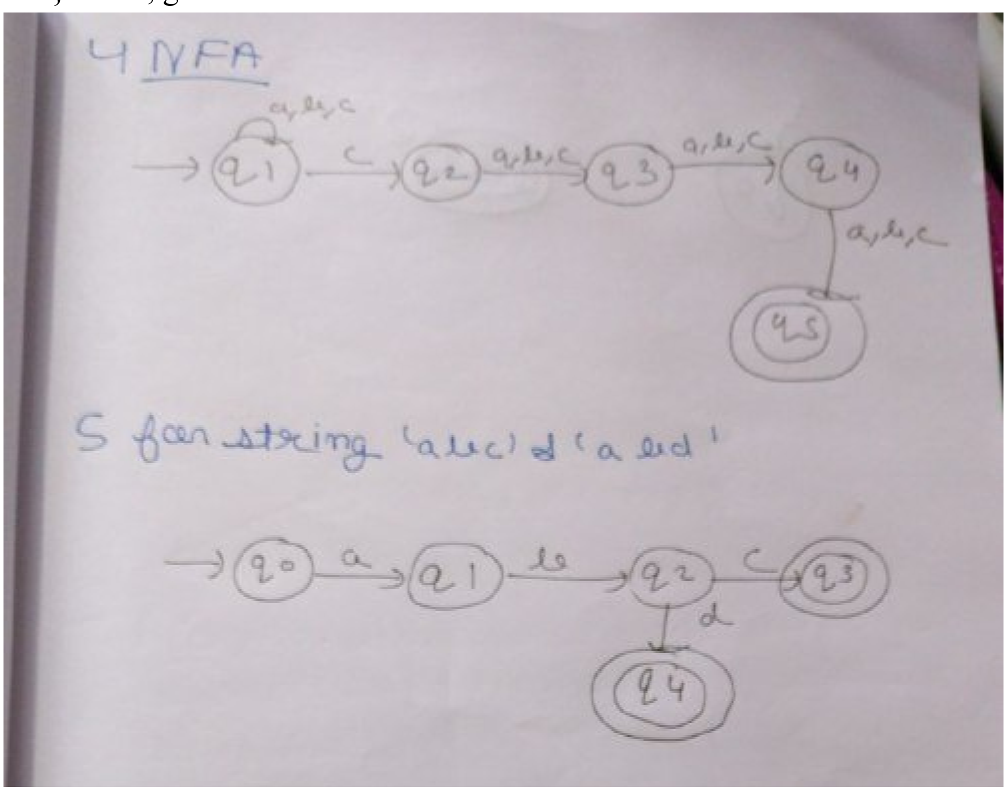
3. Construct a DFA and NFA that accepts strings that starts with ‘abb’ and ends with any number of ‘a’.



4. Ramesh has to create an FSA that accepts string over {a, b, c} in such a way that the fourth symbol from the right is always ‘c’. Can he construct both NFA and DFA? Justify your answer.



5. Is it possible to create an NFA and ε-NFA over {0,1} that accepts L={0^n 1^m 2^o| n, m, o >=0}? If so, give the construct.

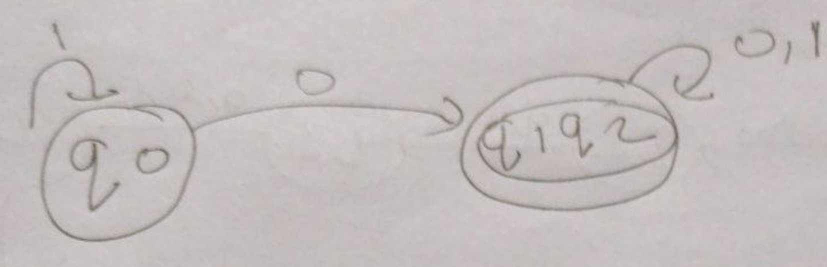


6. Is it possible to create an NFA and ε-NFA over {0,1} that accepts L={0^n 1^m 2^o| n, m, o >0}? If so, give the construct.

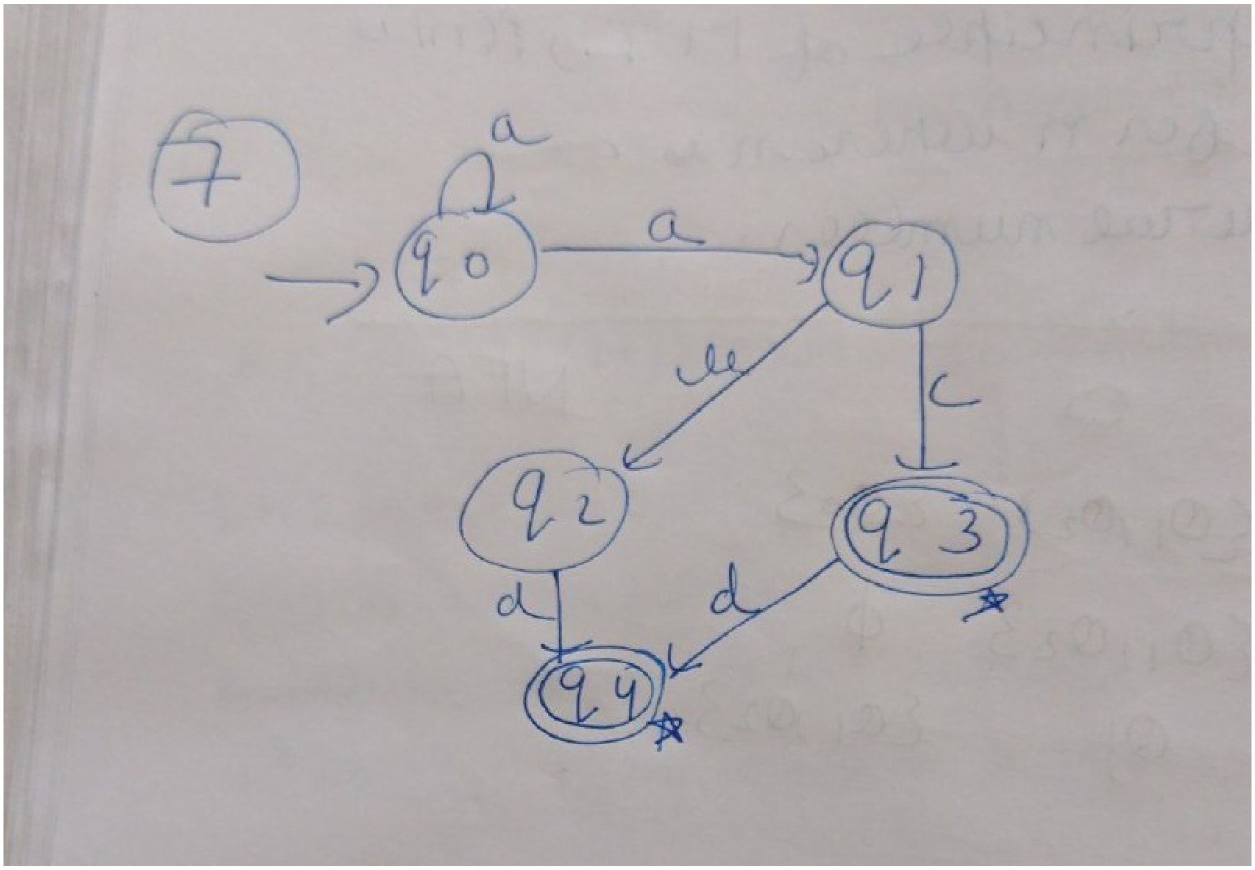
6 NFA to DFA

δ	0	1
$\rightarrow q_0$	$\{q_1, q_3\}$	$\{q_0\}$
q_1	$\{q_1, q_3\}$	$\{\phi\}$
$* q_2$	q_1	$\{q_1, q_3\}$

δ	0	1
$\rightarrow q_0$	q_1q_2	q_0
q_1q_2	q_1q_2	q_1q_2



7. Design a NFA that recognises the strings 'abc', 'abd', 'aacd' over the input Σ={a, b, c, d}.



8. Convert the following NFA to DFA:

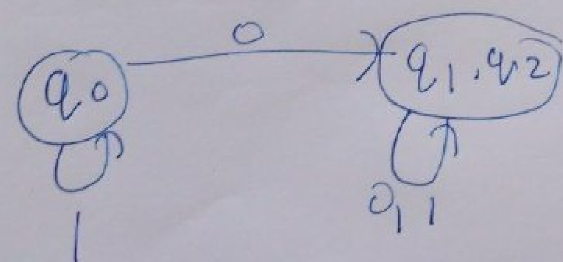
δ	0	1
->Q0	{Q1, Q2}	{Q0}
Q1	{Q1, Q2}	Φ
*Q2	Q1	{Q1, Q2}

NFA

δ	0	1
→ Q_0	$\{Q_1, Q_2\}$	$\{Q_0\}$
Q_1	$\{Q_1, Q_2\}$	ϕ
* Q_2	Q_1	$\{Q_1, Q_2\}$

DFA →

δ	0	1
Q_0	$[Q_1, Q_2]$	Q_0
$[Q_1, Q_2]$	$[Q_1, Q_2]$	$[Q_1, Q_2]$



Part – A

1. A language if accepted by DFA, will be accepted by the equivalent NDFA also. Justify your answer.

(1) Difference between DFA and NFA is that we get multiple choices in NFA. so if we have a language satisfying a DFA, it will also satisfy its equivalent NFA

2. If a NFA has n states, the the corresponding DFA has ___**2^n**__ states

3. In Qx∑ = P(Q), the power set of Q has a maximum of __**n,**________ elements for a DFA and ______**2^n**_______ elements for a NFA.

4. For NFA with epsilon moves, which of the following is correct?

a) ∂ : Qx∑ = P(Q)

b) ∂ : Qx (∑ ∪ $∑^+$) = P(Q)

c) ∂ : Qx($∑^+$) = P(Q)

d) **∂ : Qx(∑ ∪ ∈) = P(Q)**

5. The final state(s) of a NFA converted from the corresponding ∈-NFA is

a**) same final state as ∈-NFA**

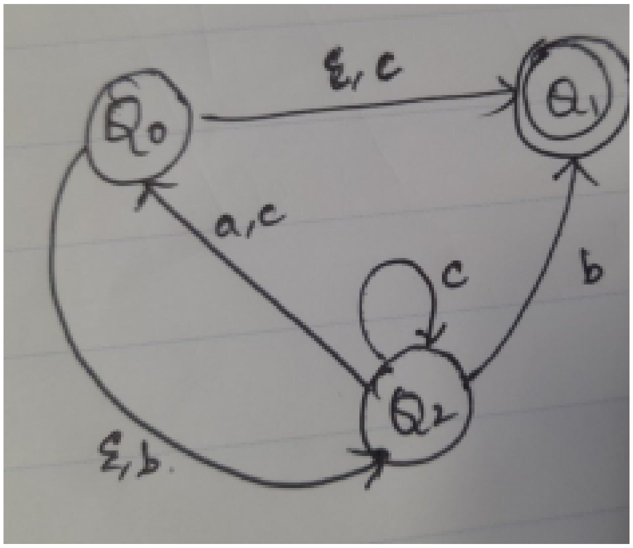
b) ∈-closure (final state of NFA)

c) All states that can reach the final state of ∈-NFA only by seeing an ∈

d) final state as the corresponding MDFA

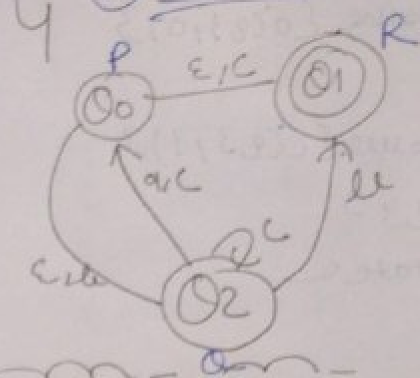
Part – B

1. Convert the below NFA to a DFA with minimal states.



Q0
Q1
Q2
ε, c
a, c
c
b
ε, b.

4 ① Part B



	a	b	c
→(P)	{P,Q,R}	{Q,R}	{Q,R}
Q	{P,Q,R}	{R}	{Q}
(R)	φ	φ	φ

nfa final state

	ε*	a	ε*
P	P	φ	φ
	Q	P	P
	R	φ	Q R

	ε*	b	ε*
P	P	Q	Q
	Q	R	R
	R	φ	—

	ε*	c	ε*
P	P	R	R
	Q	Q	Q
	R	φ	—

	ε*	b	ε*
Q	Q	R	R

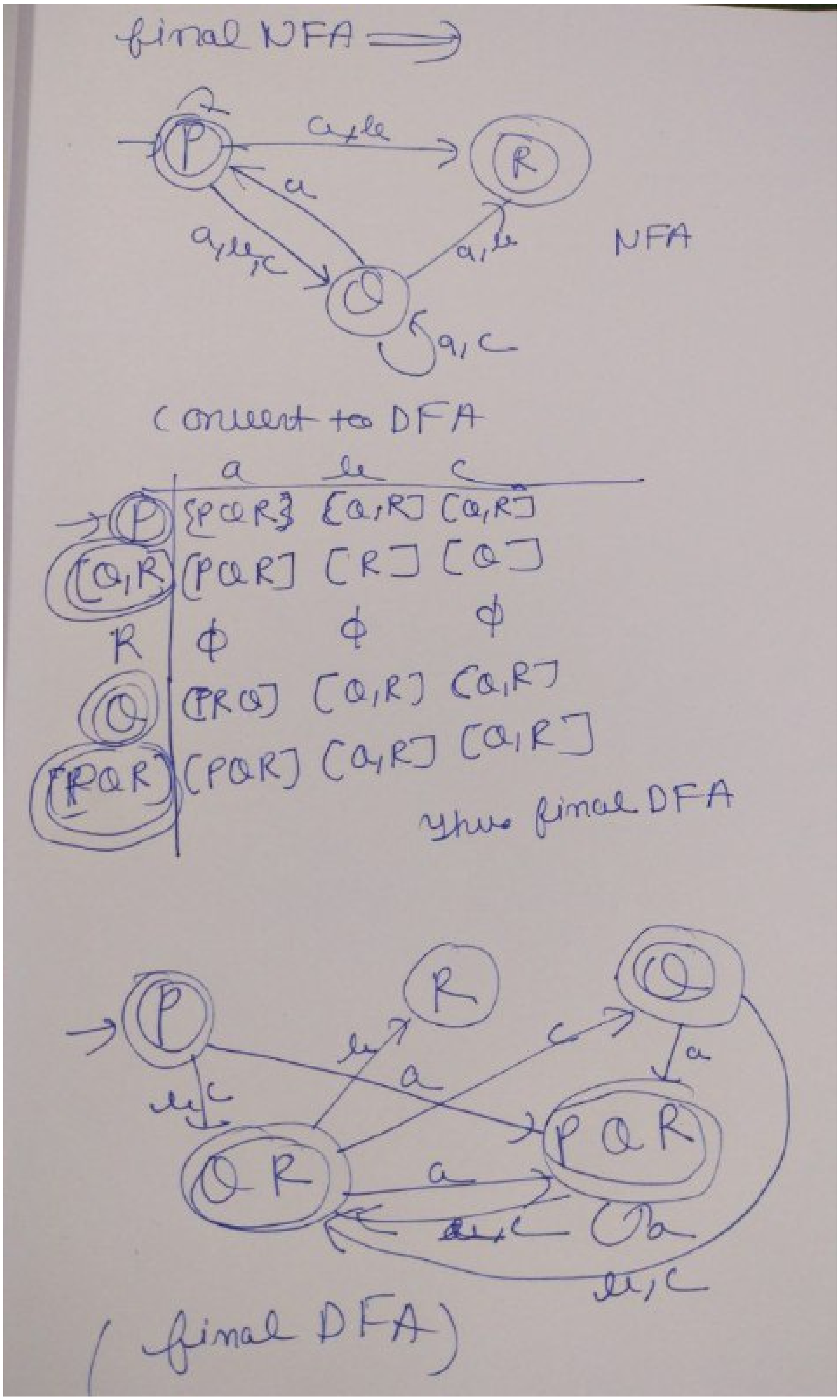
	ε*	a	ε*
Q	Q	P	PQR

	ε*	c	ε*
Q	Q	Q	Q

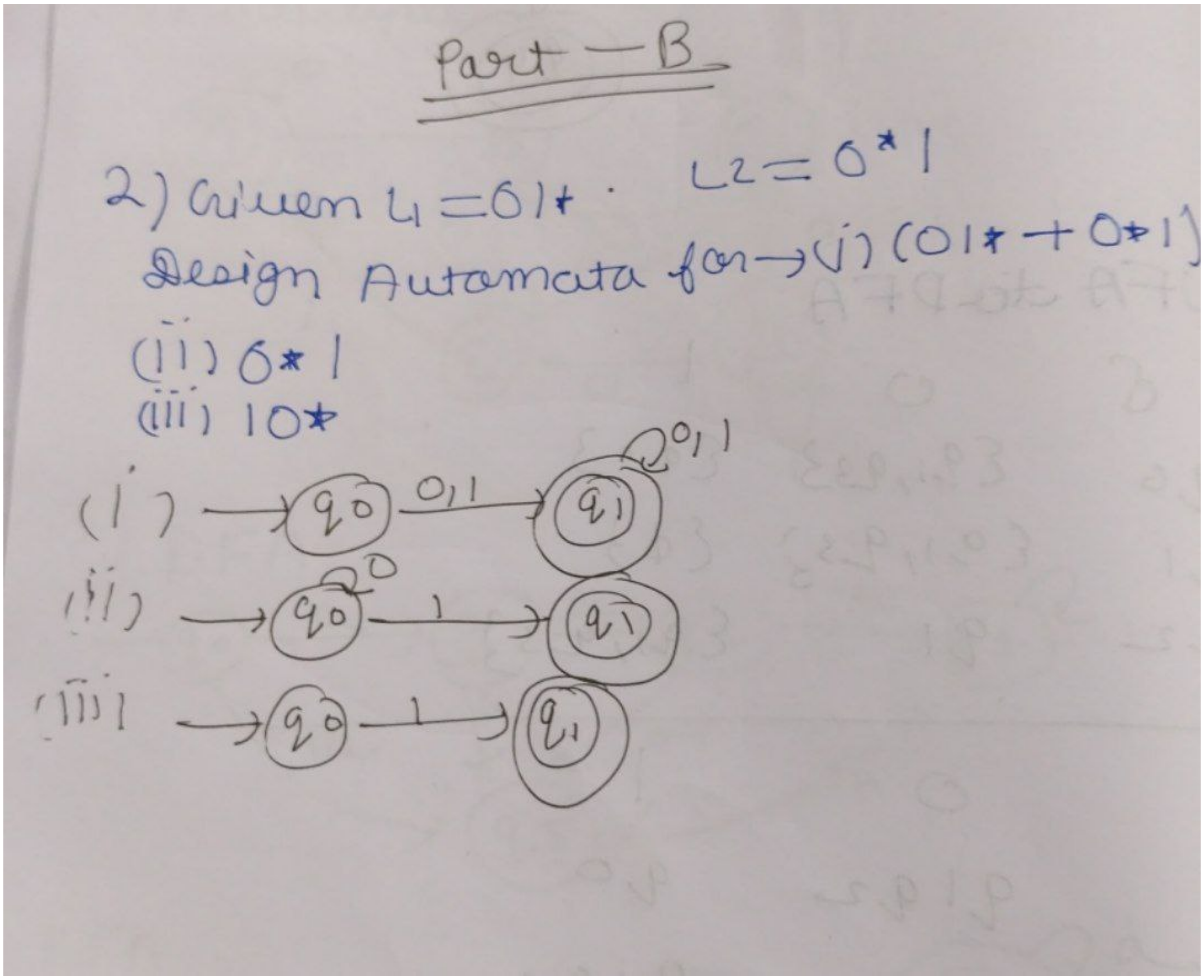
	ε*	a	ε*
R	R	Q	—

	ε*	c	ε*
R	R	φ	—

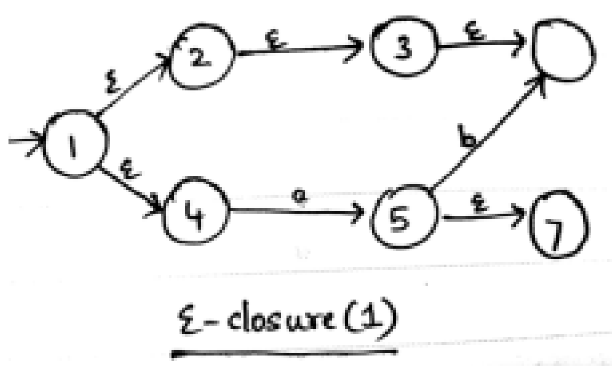
	ε*	b	ε*
R	R	φ	—



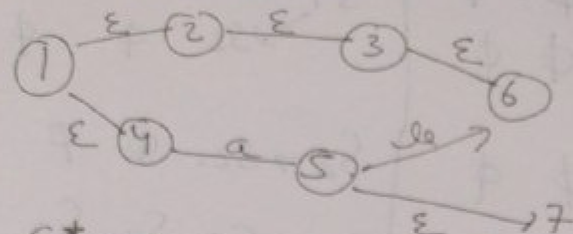
2. Given L_1=01* and L_2 = 0*1, M1 and M2 are the machines recognizing L1 and L2 respectively as shown in the figure below, design automata recognizing $L_1 \cup L_2$, L_2 and L_1^*.



3. Find the epsilon closure(1) in the following ∈-NFA.



3 find ε closure



ε^* for ① $\Rightarrow \{1, 2, 3, 6, 4\}$

$2 \Rightarrow \{2, 3, 6\}$

$3 \Rightarrow \{3, 6\}$

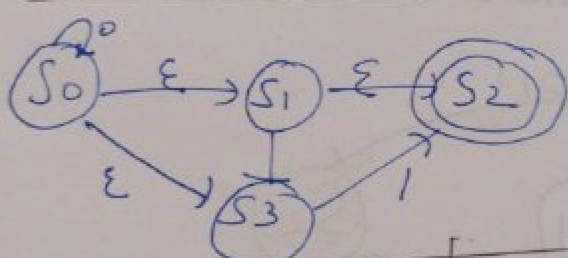
$4 \Rightarrow \{4\}$

$5 \Rightarrow \{5, 7\}$

$6 \Rightarrow \{6\}$

$7 \Rightarrow \{7\}$

5 ε-NFA to NFA

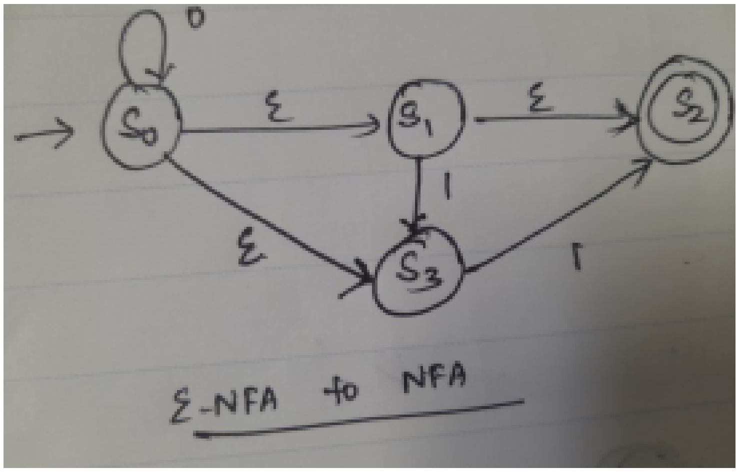


	ε^*	0	ε^*
S_0	S_0	S_0	S_0, S_1, S_3
	S_1	ϕ	
	S_3	ϕ	

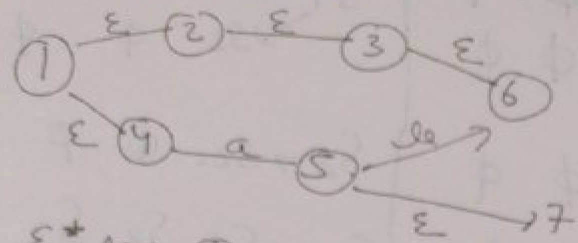
	ε^*	1	ε^*
S_0	S_0	ϕ	
	S_1	S_3	$\rightarrow S_3$
	S_3	S_2	$\rightarrow S_2$

4. Convert a DFA that accepts binary number 9 to a NFA that accepts both binary equivalents of both the numbers 5 and 9.

5. Convert the ∈-NFA in the below figure to a NFA .



3 find ε closure



ε^* for ① $\Rightarrow \{1, 2, 3, 6, 4\}$

$2 \Rightarrow \{2, 3, 6\}$

$3 \Rightarrow \{3, 6\}$

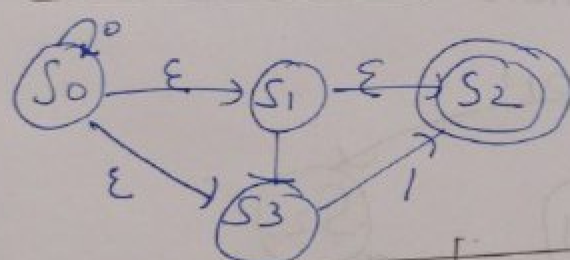
$4 \Rightarrow \{4\}$

$5 \Rightarrow \{5, 7\}$

$6 \Rightarrow \{6\}$

$7 \Rightarrow \{7\}$

5 ε-NFA to NFA



	ε^*	0	ε^*
S_0	S_0	S_0	S_0, S_1, S_3
	S_1	ϕ	
	S_3	ϕ	

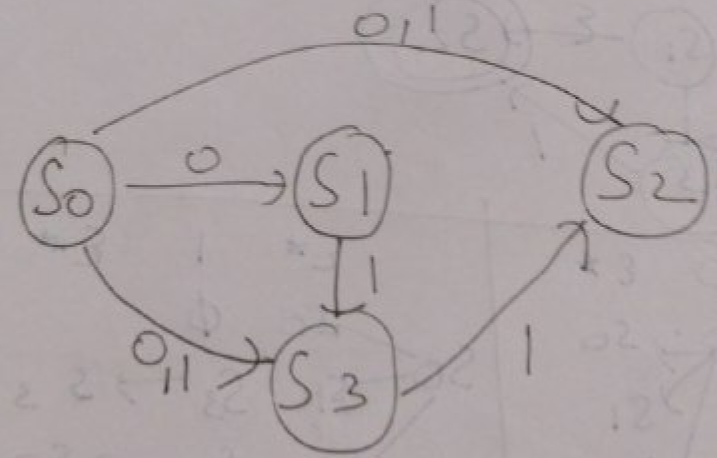
	ε^*	1	ε^*
S_0	S_0	ϕ	
	S_1	S_3	S_3
	S_3	S_2	S_2

	ε^*	0	ε^*
$S_1 \to$	S_1	$\phi \to$	ϕ
$\searrow$	S_2	ϕ	ϕ
S_2	S_2	ϕ	ϕ
S_3	S_3	ϕ	ϕ

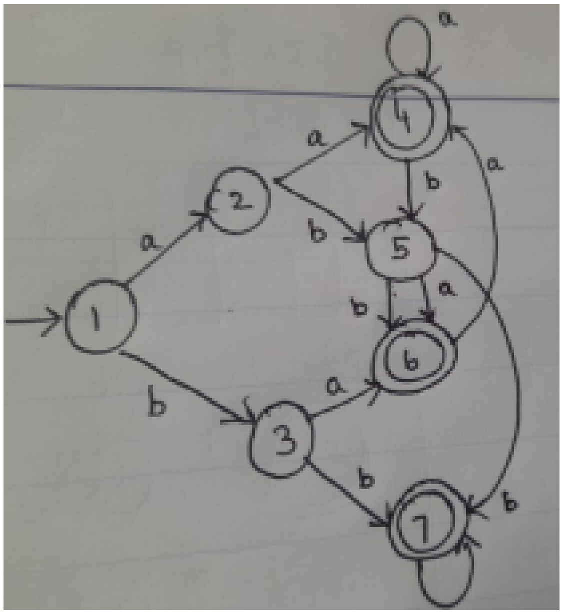
	ε^*	1	ε^*
$S_1 \to$	S_1	S_3	S_3
$\searrow$	S_2	ϕ	ϕ
$S_2 \to$	S_2	ϕ	ϕ
$S_3 \to$	S_3	S_2	S_2

	0	1
S_0	$\{S_0, S_1, S_2, S_3\}$	$\{S_2, S_3\}$
S_1	$\{\phi\}$	$\{S_3\}$
S_2	$\{\phi\}$	$\{\phi\}$
S_3	$\{\phi\}$	$\{S_2\}$

(transition table)

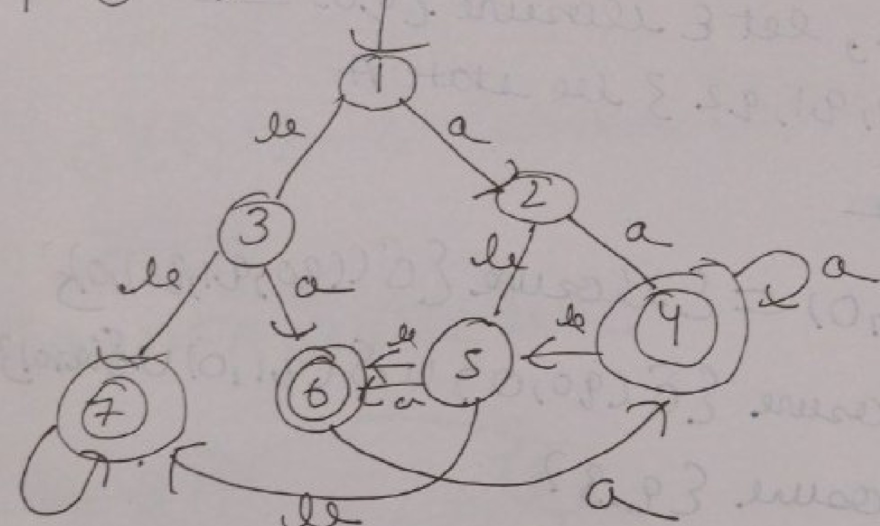


6. Check whether the below DFA is minimized, if not minimize it.

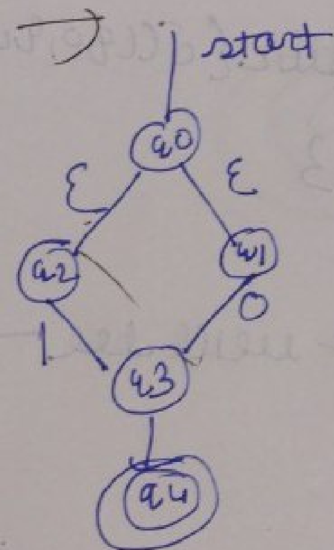


1
2
3
4
5
6
7
a
b

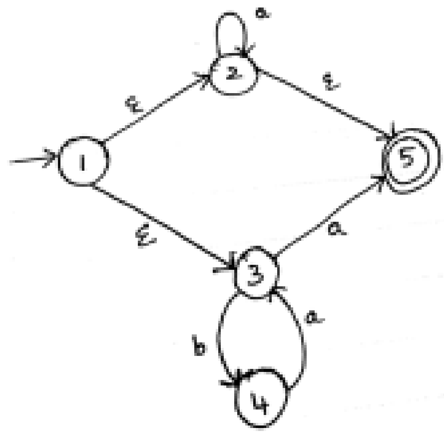
4·6 →



4·7 →



7. Find the minimum state DFA accepted by the following ∈-NFA.



a
ε
ε
1
2
5
ε
a
3
b
a
4

• Solution

Let us obtain ϵ-closure of each state

$\epsilon\text{-closure}\{q_0\} = \{q_0, q_1, q_2\}$

$\epsilon\text{-closure}\{q_1\} = \{q_1\}$

$\epsilon\text{-closure}\{q_2\} = \{q_2\}$

$\epsilon\text{-closure}\{q_3\} = \{q_3\}$

$\epsilon\text{-closure}\{q_4\} = \{q_4\}$

Now, let ϵ closure $\{q_0\} =$ $\{q_0, q_1, q_2\}$ be state A

Hence

$\delta'(A,0) = \epsilon\text{ closure } \{\delta((q_0,q_1,q_2),0)\}$

$\epsilon\text{-closure } \{\delta(q_0,0) \cup \delta(q_1,0) \cup \delta(q_2,0)\}$

$\epsilon\text{-closure } \{q_3\}$

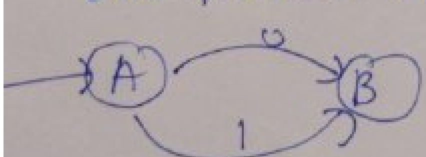
$\{q_3\}$ call it state B

$\delta'(A,1) = \epsilon\text{-closure}\{\delta((q_0,q_1,q_2),1)\}$

$= \epsilon\text{-closure}\{q_3\}$

$\{q_3\} = B.$

The partial DFA will be →



now.

$\delta'(B,0) = \varepsilon\text{-closure}\{\delta(q3,0)\}$

$= \Psi$

$\delta'(B,1) = \varepsilon\text{-closure}\{\delta(q3,1)\}$

$= \varepsilon\text{-closure}\{q4\}$

$= \{q4\}$ ie. state C

for state C

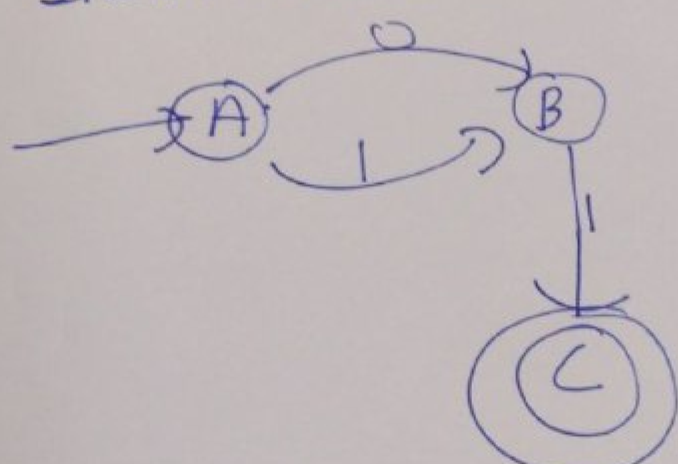
$\delta'(C,0) = \varepsilon\text{-closure}\{\delta(q4,0)\}$

$= \phi$

$\delta'(C,1) = \varepsilon\text{-closure}\{\delta(q4,1)\}$

$= \phi$

The DFA will be



PART A

1. Regular expression for all strings starts with ab and ends with bba is.
    a) aba*b*bba
    b) ab(ab)*bba
    c) ab(a+b)*bba
    d) All of the mentioned
2. Under which of the following operations, NFA is not closed?
    a) Negation
    b) Kleene
    c) Concatenation
    d) None of the mentioned
3. Ragu is asked to make an automaton which accepts a given string for all the occurrences of '1001' in it. How many number of transitions would John use such that the string processing application works?
    a) 9
    b) 11
    c) 12
    d) 15

4. Which of the following does not represent the given language? Language: {0,01}
    a) 0+01
    b) {0} U {01}
    c) {0} U {0}{1}
    d) {0} ^ {01}

5. Which among the following looks similar to the given expression?
    ((0+1). (0+1)) *
    a) {xϵ {0,1} *|x is all binary number with even length}
    b) {xϵ {0,1} |x is all binary number with even length}
    c) {xϵ {0,1} *|x is all binary number with odd length}
    d) {xϵ {0,1} |x is all binary number with odd length}

6. RR* can be expressed in which of the forms:
    a) R+
    b) R-
    c) R+ U R-
    d) R

7. Which of the following represents a language which has no pair of consecutive 1's if ∑= {0,1}?
    a) (0+10)*(1+ε)
    b) (0+10)*(1+ε)*
    c) (0+101)*(0+ε)
    d) (1+010)*(1+ε)

8. Let the class of language accepted by finite state machine be L1 and the class of languages represented by regular expressions be L2 then
    a) L1<L2
    b) L1>=L2
    c) L1 U L2 = .*
    d) L1=L2

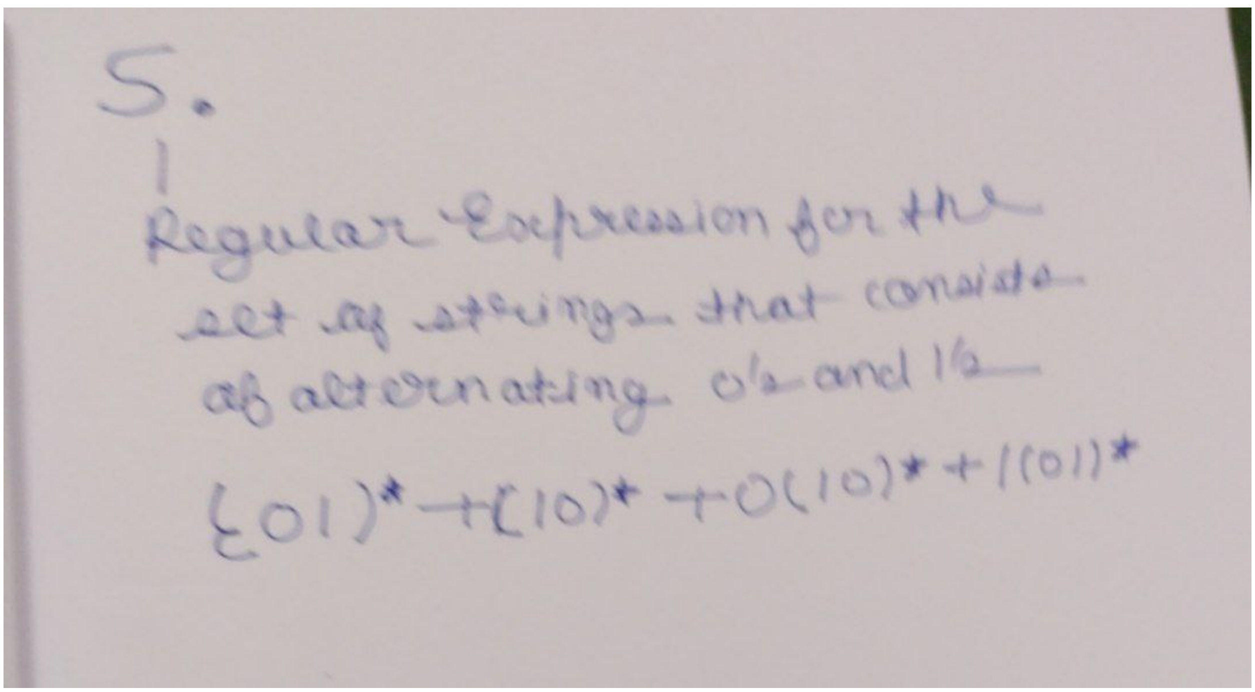
9. Let N (Q, ∑, δ, q0, A) be the NFA recognizing a language L. Then for a DFA (Q', ∑, δ', q0', A'), which among the following is true?
    a) Q' = P(Q)

b) Δ’ = δ’ (R, a) = {q ϵ Q | q ϵ δ (r, a), for some r ϵ R}
c) Q’ = {q0}
d) All of the mentioned

10. If L1 and L2′ are regular languages, L1 ∩ (L2′ U L1′)’ will be
a) regular
b) non regular
c) may be regular
d) none of the mentioned

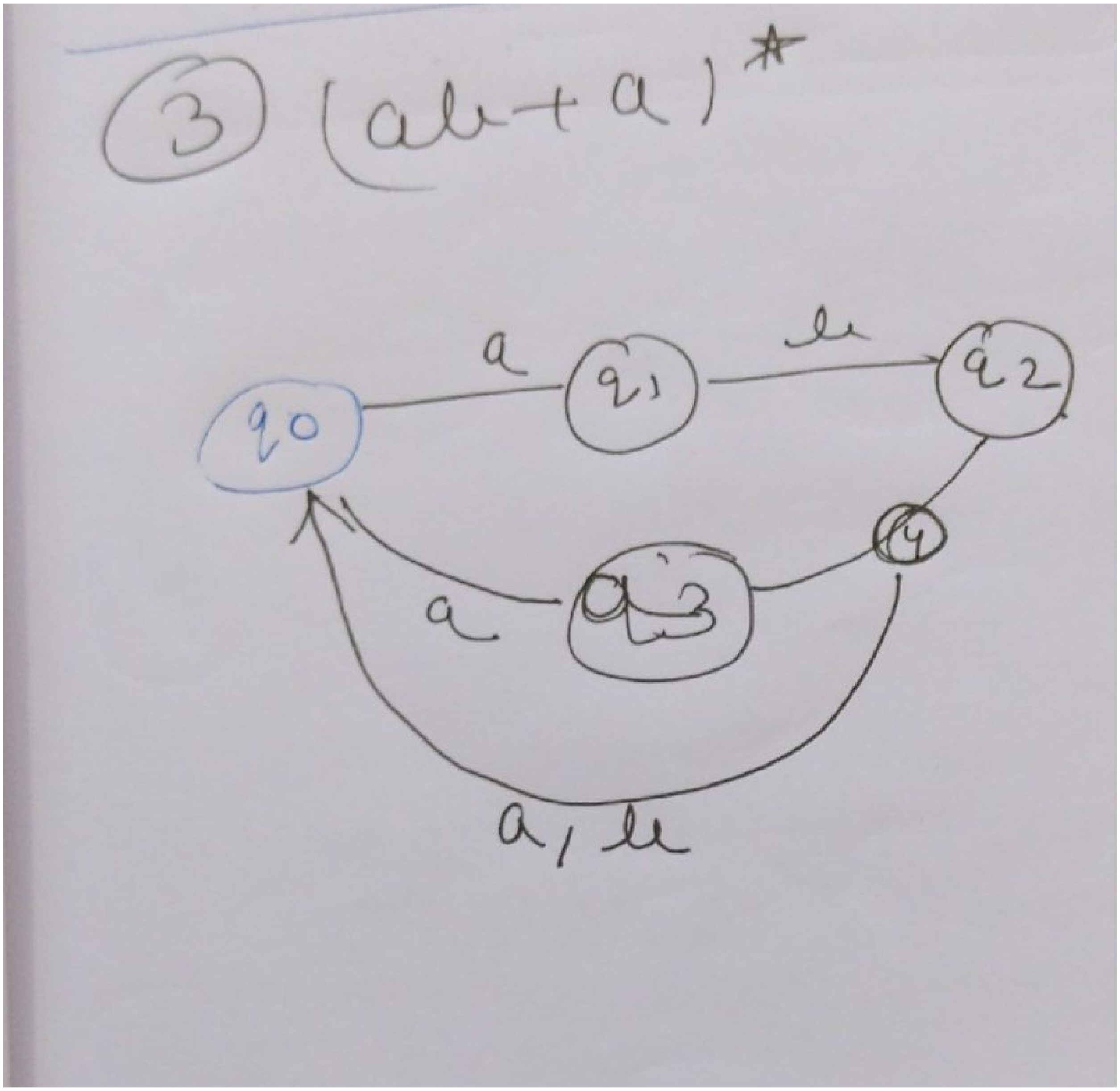
PART-B

1. Describe a Regular Expression. Write a Regular Expression for the set of strings that consists of alternating 0’s and 1’s.
(01)* + (10)* + 0(10)* + 1(01)*
{The regular expression would be }

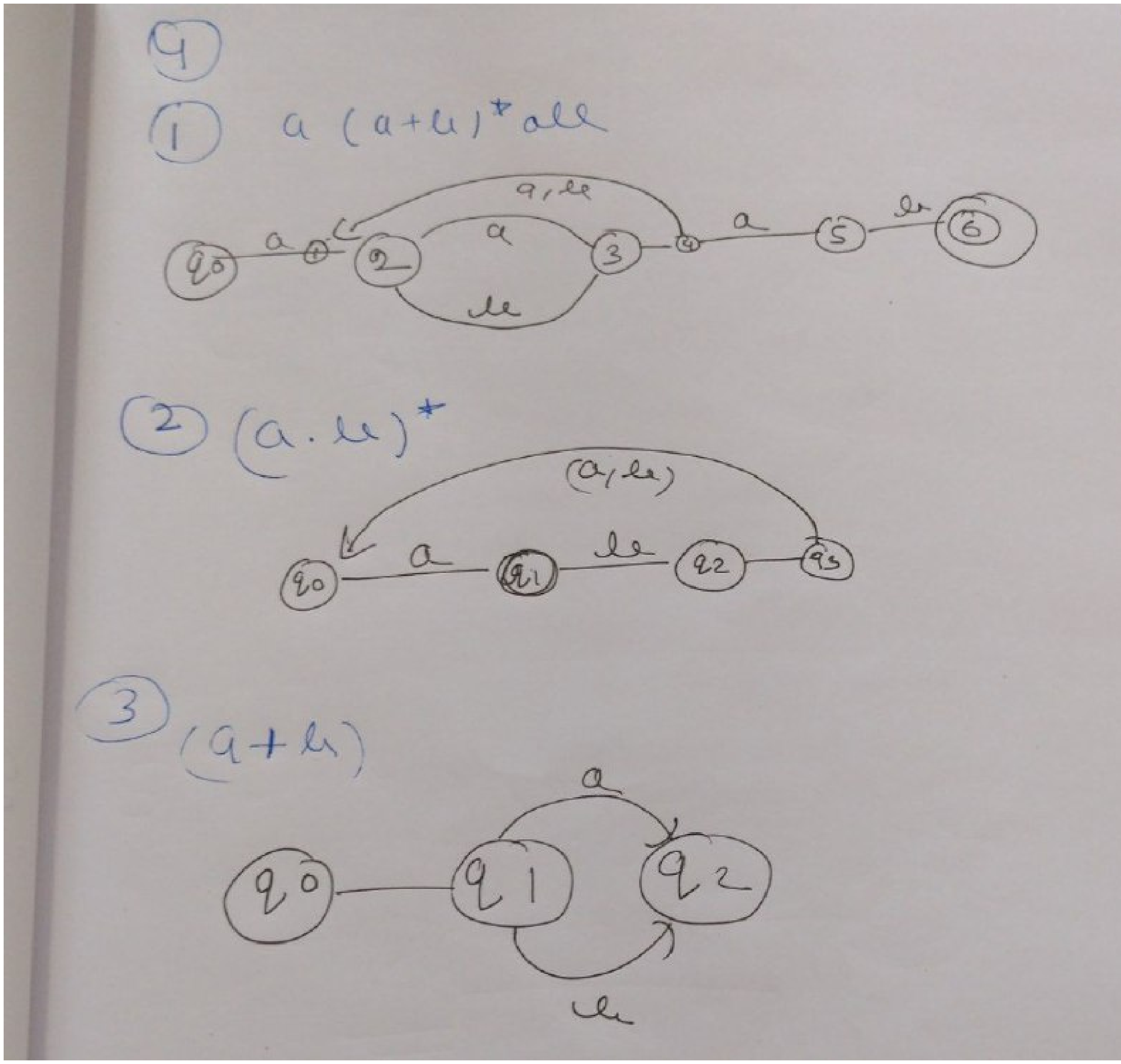

5.
1
Regular Expression for the set of strings that consists of alternating 0's and 1's
(01)* + (10)* + 0(10)* + 1(01)*

2. Examine whether the language L=(0^n 1 n | n>=1) is regular or not? Justify your answer.

3. Construct Finite Automata equivalent to the regular expression (ab+a)*

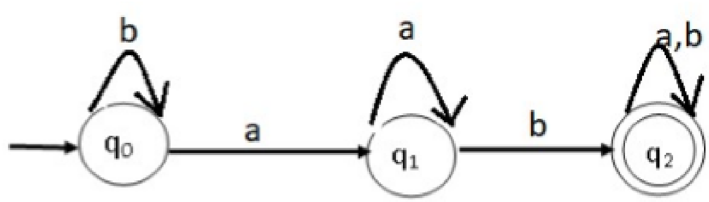


4. Construct NDFA for given RE using Thomson rule.
   i) a(a+b)* ab
   ii) (a.b)*
   iii) (a+b)

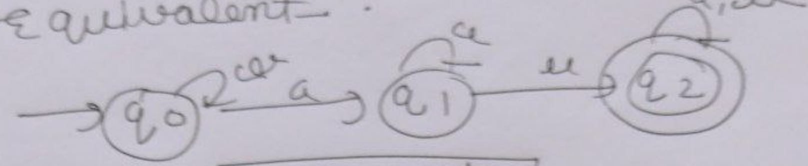


iv)

5. Find the Regular Expression equivalent for the given Finite Automata.



5 The Regular Expression equivalent.



$= \boxed{aa^*bb^*}$

6. Evaluate the equalities for the following RE and prove for the same

(i) b+ab* +aa*b+aa*ab*

5.

06

$b + ab^* + aa^*b + aa^*ab^*$

$= b + ab^* + aa^*b + aa^*ab^*$

$= (b + aa^*b) + (ab^* + aa^*ab^*)$

$= (\Lambda + aa^*)b + (\Lambda + aa^*)ab^*$

{ distributive property }

$= (a^*b) + (a^*)ab^*$ from $\Lambda + aa^* = a^*$

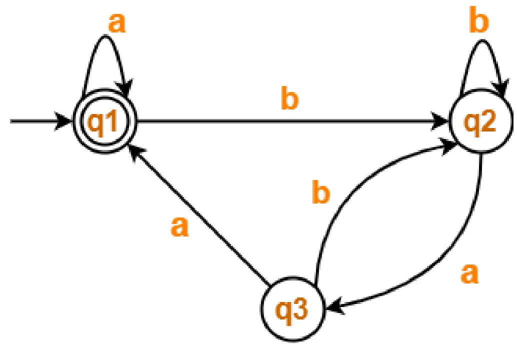
$= a^*b + a^*.ab^*$

$= a^*(b + ab^*)$ distributive property

(ii) a*(b+ab*).

(iii) a(a+b)*+aa(a+b)*+aaa(a+b)*

7. Find the Regular Expression equivalent for the given Finite Automata.



7) Find Regular Expression →

The transitions are defined by →

$q1 = q1 0 + q3 0 + \varepsilon$ —(1)

$q2 = q1 1 + q2 1 + q3 1$ —(2)

$q3 = q2 0$

Substitute (3) in (2)

$q2 = q1 1 + q2 1 + q2 01$

$q2 = q1 1 + q2(1+01)$

$q2 = q1 1 (1+01)^*$ —(4)

put (4) in 1

$q_1 = q_1 0 + q_2 00 + \varepsilon$

$= q_1 0 + q_1 1 (1 + 01)^* 0.0 + \varepsilon$

$= q_1 0 + q_1 (1 + (1 + 01)^* 00) + \varepsilon$

$= q_1 (0 + 1 (1 \cancel{0} + \cancel{1})^* 00) + \varepsilon$

$= \varepsilon (0 + 1 (1 + 01)^* 00)^*$

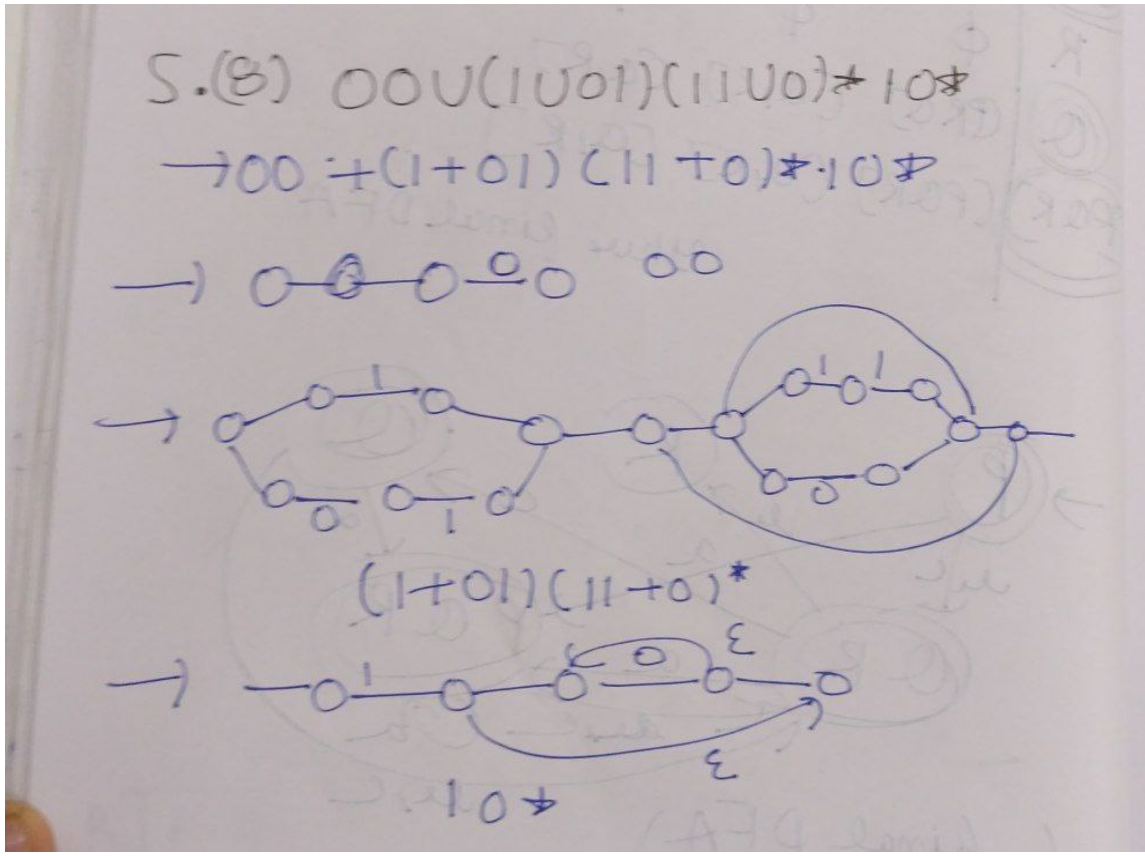
$= q_1 = (0 + 1 (1 + 01)^* 00)^*$

The final expression is

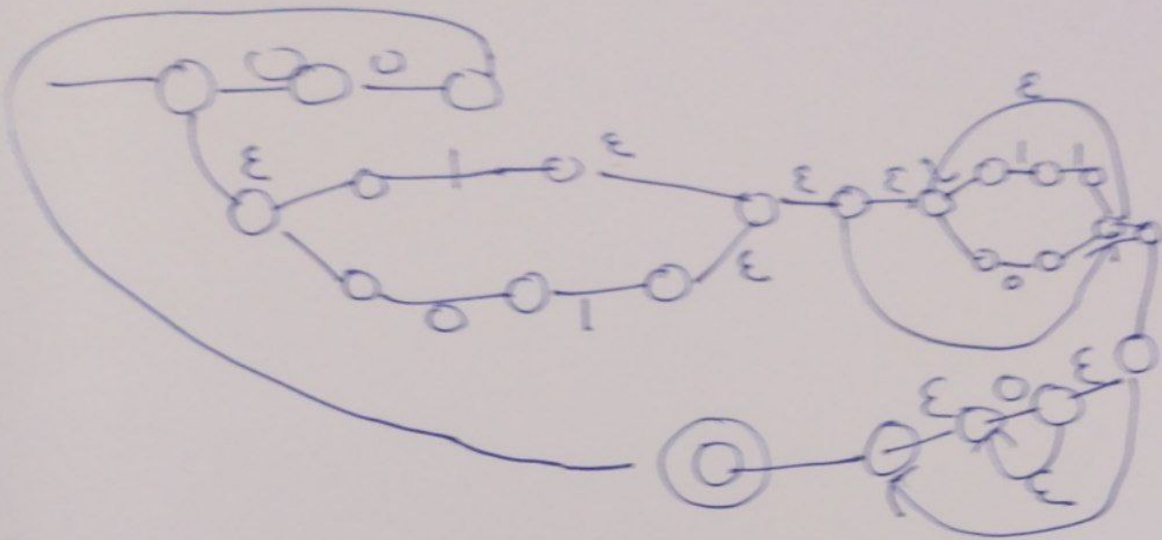
$(0 + 1 (1 + 01)^* 00)^*$

8. Construct a DFA which is equivalent to the following regular expression:

00 ∪ (1 ∪ 01)(11 ∪ 0)∗10 ∗



Joining all of them →



$00+(1+01)(11+0)^*10^*$