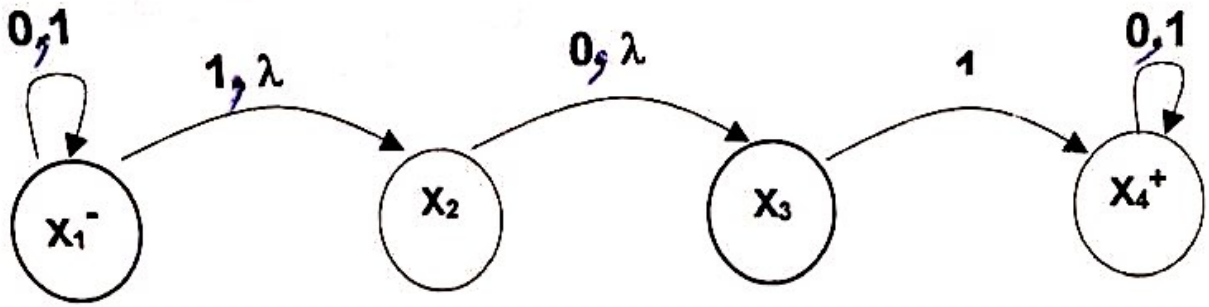
Q1. Convert the following NFA into equivalent DFA. [5 marks]



	0	1
- X1	X1	X1,X
X2	X3	ϕ
X3	ϕ	X
+X4	X4	X

5- CNF has:

A) One Nullable production
B) One unit production
C) One λ-production
D) Two unit productions
E) None of the above

6- What is the equivalent regular expression for the expression r = a*b over the Σ = {a,b}?

A) (a+b)*b
B) a*b*b
C) (λ+a (aa)*)* (λ + a)b + b
D) (a*+b)*b
E) aa*b*b*

7- Which of the regular expression below gives the set of all strings with an equal number of a's and b's?

A) (aa+ab+ba+bb)*
B) ba(a+b)*ab
C) (a+b)*
D) (ab)* + (ba)*
E) (ba+ab)*

8- Which regular expression represents the strings do not contain the substring aa over {a,b}?

A) (ab+ba)*
B) (ba+b)*(λ+a)
C) (aba)*
D) (ab)*
E) (λ+a)(ab+b)*

KEY

Question	1	2	3	4	5	6	7	8
Answer	E	D	C	E	E	C	E	D

Q2. Consider $\Sigma = \{ 0, 1, 2, 3 \}$, construct CFG that can generates any number whose sum of its digits is even. (5 marks)

$S \longrightarrow XS$

$S \longrightarrow SX$

$S \longrightarrow YSY$

$S \longrightarrow \lambda$

$X \longrightarrow 00, 11, 22, 33$

$Y \longrightarrow 02, 13, 20, 31$

110 ?

310 .

Q2. Consider $\Sigma = \{ a, b \}$, construct CFG that can generates any word that does not contain double a. (5 marks)

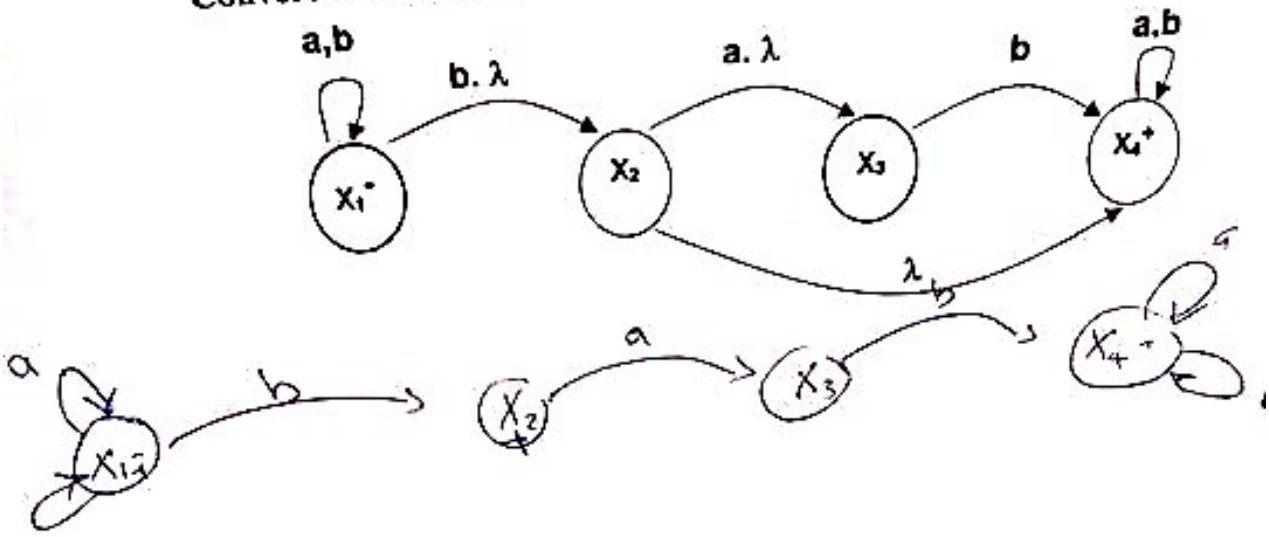
bab

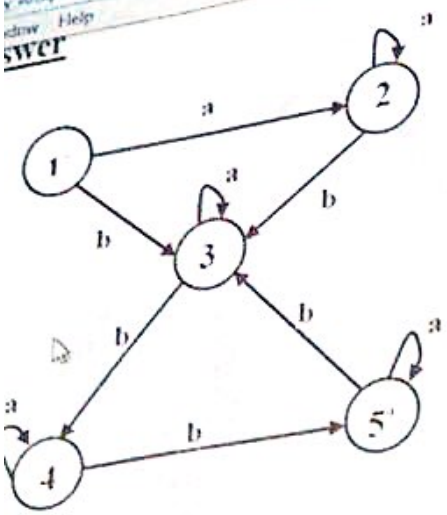
aba ?

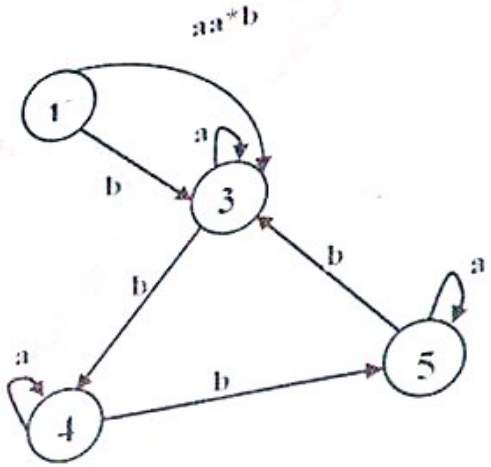
$S \longrightarrow bSb$

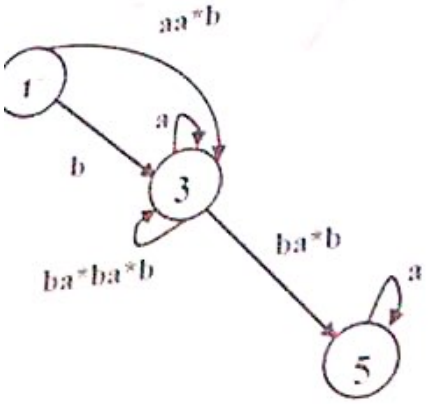
$S \longrightarrow a$

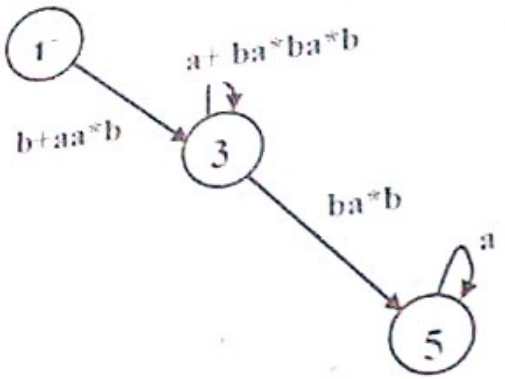
Q2. (7 marks)
Convert the following NFA into equivalent DFA

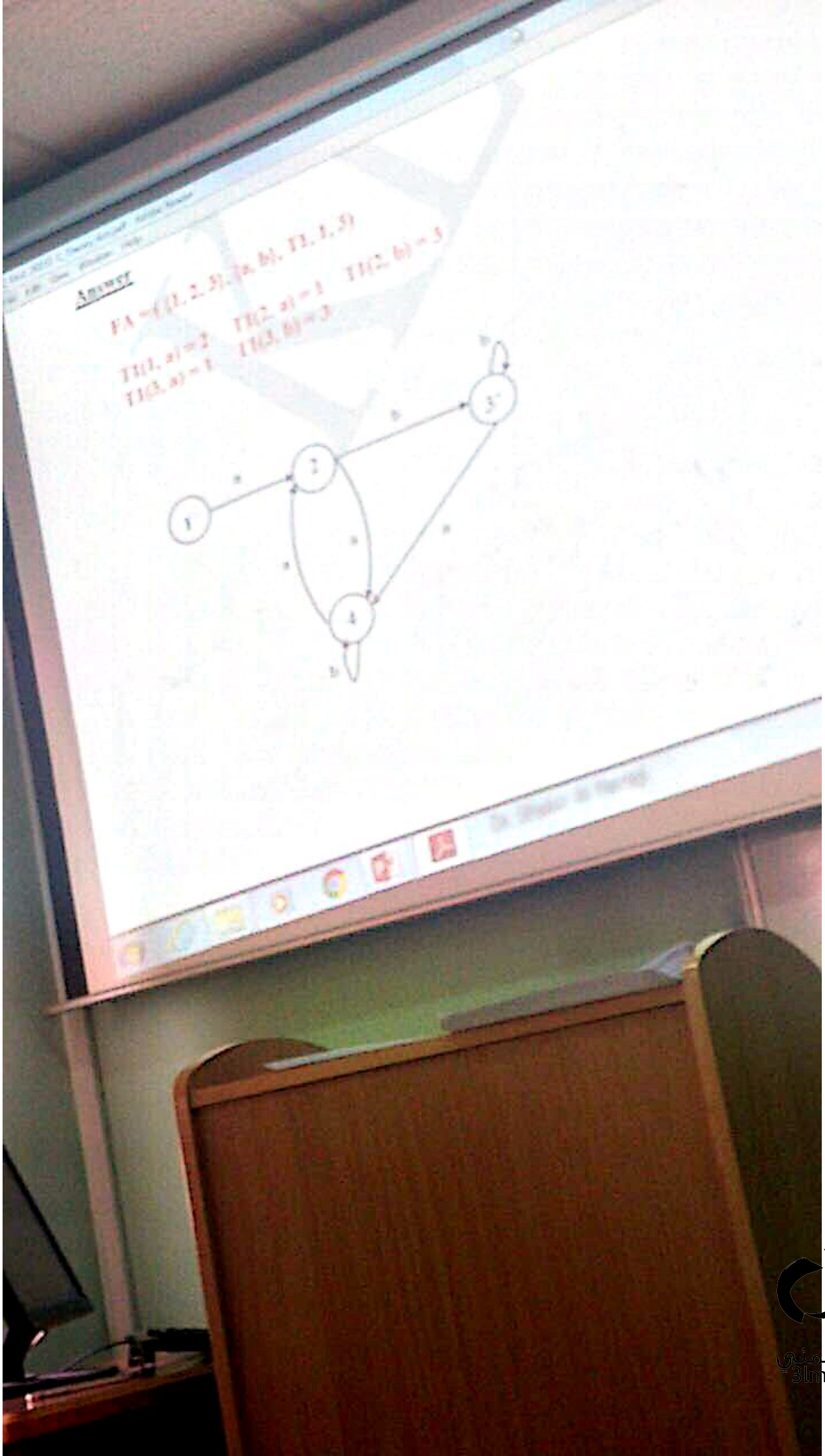


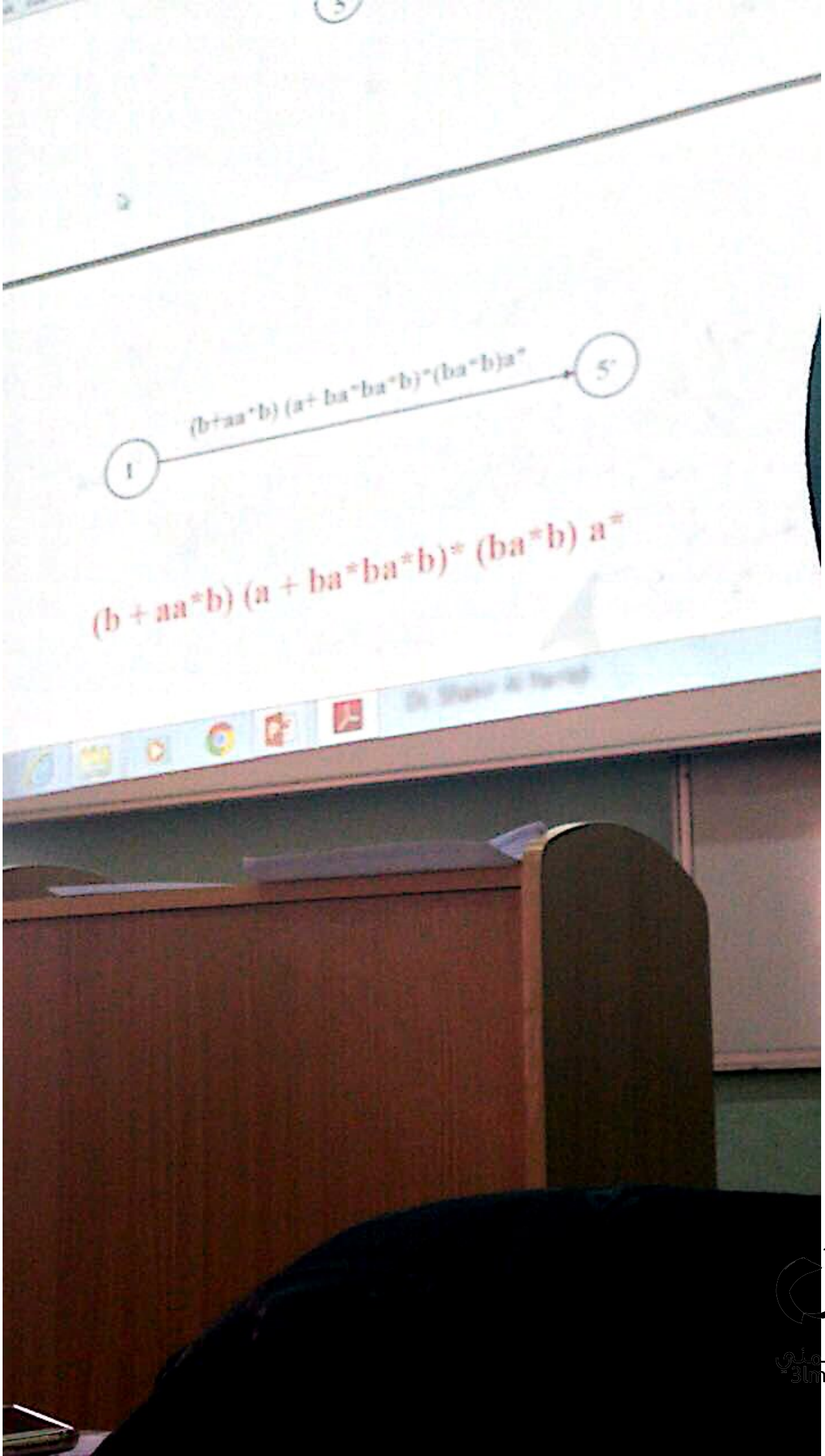

1
2
3
4
5
a
b


aa*b
1
3
4
5
a
b


aa*b
1
3
5
a
b
ba*b
ba*ba*b


1
a+ ba*ba*b
b+aa*b
3
ba*b
5
a


Answer
FA = {{1, 2, 3}, {a, b}, T1, 1, 3}
T1(1, a) = 2 T1(2, a) = 1 T1(2, b) = 3
T1(3, a) = 1 T1(3, b) = 3
1
2
3
4
a
a
a
b
b
b


(b+aa*b) (a+ ba*ba*b)*(ba*b)a*
5
1
(b + aa*b) (a + ba*ba*b)* (ba*b) a*

Q3. Covert the following CFG into CNF: (7 marks)

$S \rightarrow X\$ \mid Y \mid aSa$
$X \rightarrow aX \mid abY$
$Y \rightarrow bYb \mid bY \mid \lambda$

$S \rightarrow X\$$

$S \rightarrow bYb$

$S \rightarrow aSa$

$S \rightarrow aaX$

$X \rightarrow aX$

$X \rightarrow abY$

$X \rightarrow ab$

$Y \rightarrow bYb$

$Y \rightarrow b$

$S \rightarrow$

Q1. Consider Σ = { 0, 1, 2, 3 }, construct CFG that can generates any number whose sum of its digits is even. **(7 marks)**

$S \rightarrow XY \mid A \mid B$

$S \rightarrow XX$

$S \rightarrow YY$

$XX \rightarrow \lambda$

$YY \rightarrow \lambda$

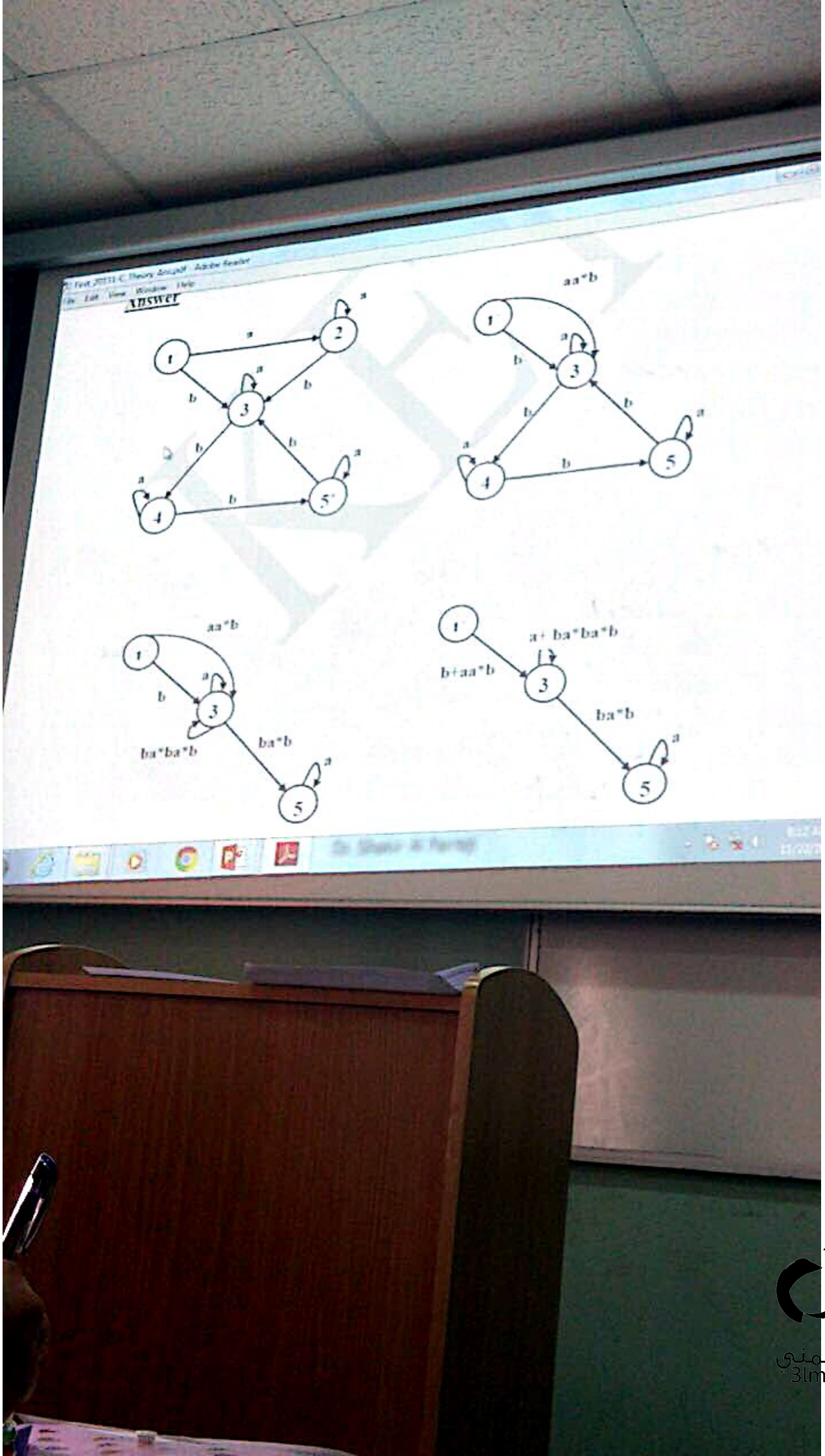
$X \rightarrow 0 \mid 1 \mid 2 \mid 3$

$Y \rightarrow 0 \mid 1 \mid 2 \mid 3$

$S \rightarrow XX \rightarrow 0X \rightarrow 03\ \alpha$

$S \rightarrow XY \rightarrow 3Y \rightarrow 32\ \alpha$

2


ANSWER
aa*b
aa*b
b+aa*b
a+ ba*ba*b
ba*b
ba*ba*b
ba*b

Fall 2015] C Theory Ans.pdf - Adobe Reader

File Edit View Window Help

$$(b + aa^*b)\,(a + ba^*ba^*b)^*\,(ba^*b)\,a^*$$

Q2. Consider $\Sigma = \{a, b\}$ find regular expression for the language that each wo
contain triple a. [7 Marks]

Answer

$$(b^* + \lambda)\,(abb^* + aabb^*)^*\,(\lambda + a + aa)$$

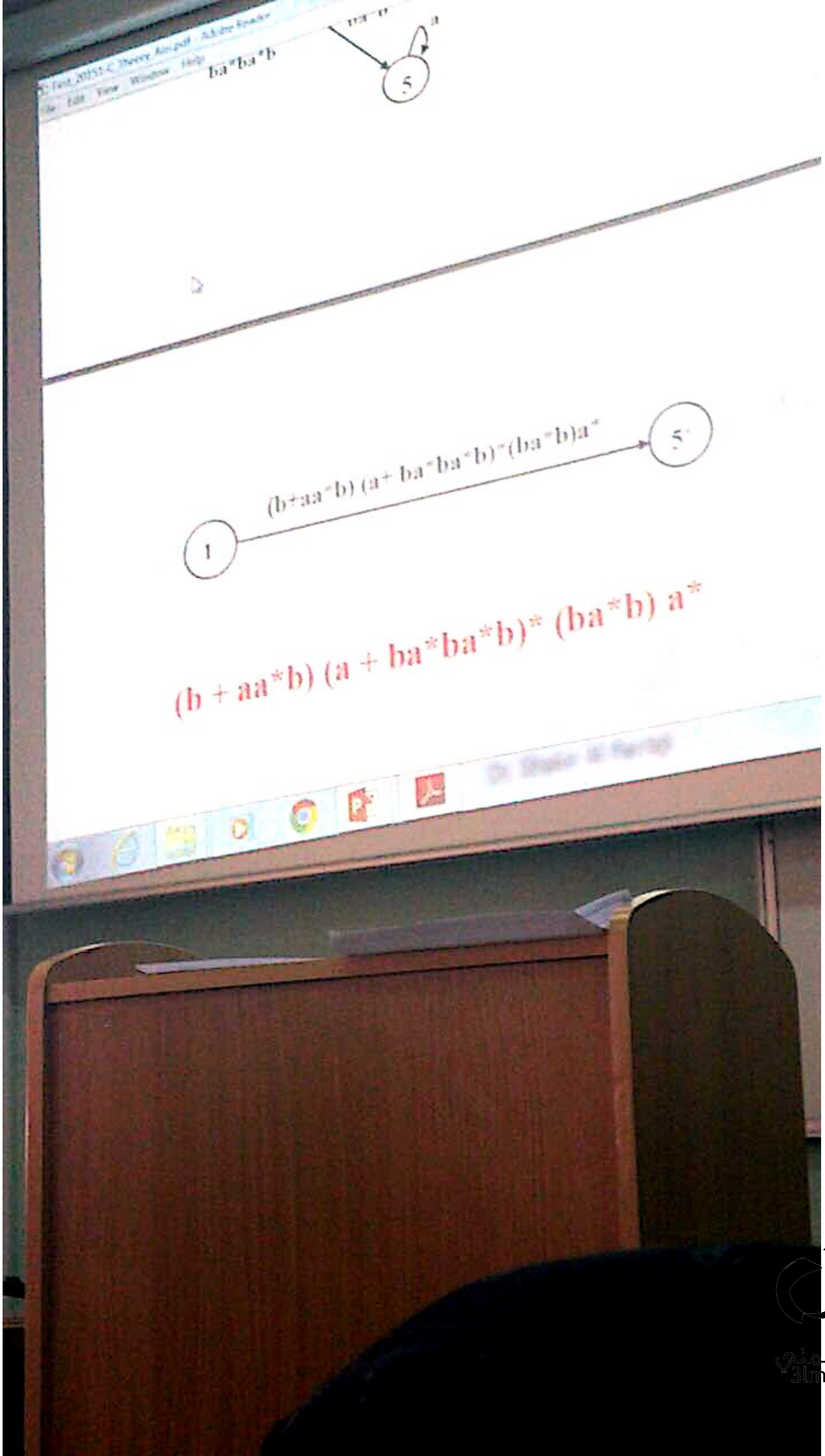
Q3. Consider $\Sigma = \{a, b\}$ construct a DFA that accept any word start with a a
and the total number of a's are odd. [7 Marks]

Answer

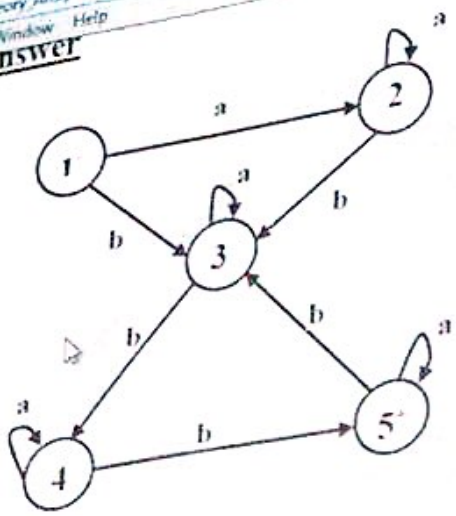
$FA = (\{1, 2, 3\}, \{a, b\}, T1, 1, 3)$

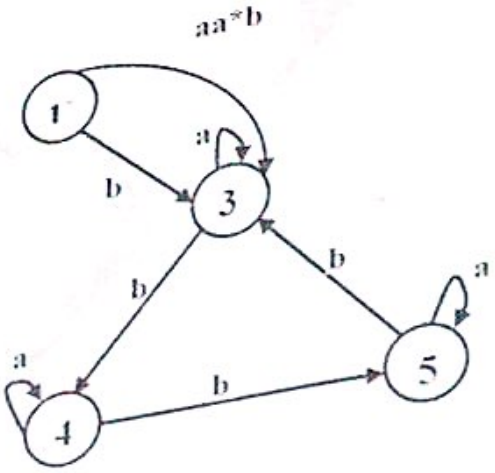
$T1(1, a) = 2 \quad T1(2, a) = 1 \quad T1(2, b) = 3$

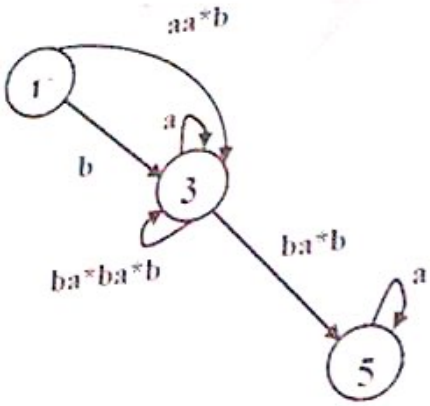
$T1(3, a) = 1 \quad T1(3, b) = 3$

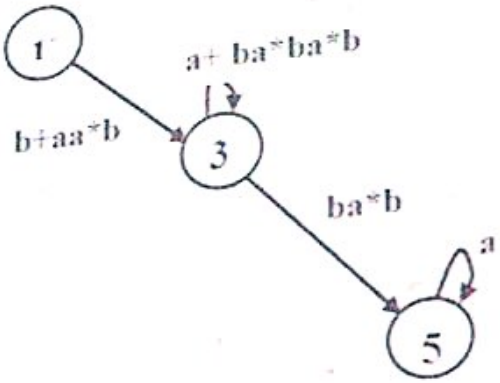

ba*ba*b
5
(b+aa*b) (a+ ba*ba*b)*(ba*b)a*
1
5'
(b + aa*b) (a + ba*ba*b)* (ba*b) a*

Answer


1
2
3
4
5
a
a
a
b
b
b
b
b
a
a

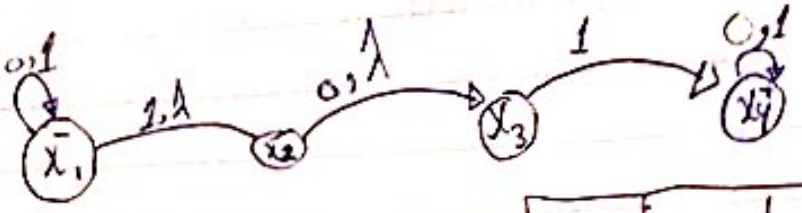

aa*b
1
3
4
5
a
b
b
b
b
a
a


aa*b
1
3
5
a
b
ba*b
ba*ba*b
a


1
a+ ba*ba*b
b+aa*b
3
ba*b
5
a

Q1 Convert from NFA to DFA

NFA



Continue of the Answer

$\lambda(x_1) = \{x_1, x_2, x_3\}$

$\lambda(x_2) = \{x_2, x_3\}$

$\lambda(x_3) = \{x_3\}$

$\lambda = \{x_4\}$

start $\lambda(x_1) = \{x_1, x_2, x_3\}$

	0	1
x_1, x_2, x_3	x_1, x_2, x_3	x_1, x_2, x_3, x_4
x_1, x_2, x_3, x_4	x_1, x_2, x_3, x_4	x_1, x_2, x_3, x_4

$TD(\{x_1, x_2, x_3\}, 1) = \{x_1, x_2, x_4\}$
$= (\lambda\{x_1\} \cup \lambda\{x_2\} \cup \lambda\{x_4\})$
$= x_1, x_2, x_3, x_4$

$TD(\{x_1, x_2, x_3\}, 0) = \{x_1, x_3\}$
$= (\lambda\{x_1\} \cup \lambda\{x_3\})$
$= x_1, x_2, x_3$

$TD(\{x_1, x_2, x_3, x_4\}, 1) = \{x_1, x_2, x_4\}$
$= (\lambda\{x_1\} \cup \lambda\{x_2\} \cup \lambda\{x_4\})$
$= x_1, x_2, x_3, x_4$

$TD(\{x_1, x_2, x_3, x_4\}, 0) = \{x_1, x_3, x_4\}$
$= (\lambda\{x_1\} \cup \lambda\{x_3\} \cup \lambda\{x_4\})$
$= x_1, x_2, x_3, x_4$

Q3 Give the regular L, that represented by the following FA:

$$FA = (\{y_1, y_2, y_3\}, \{a, b\}, t, y_1, \{y_2, y_3\})$$

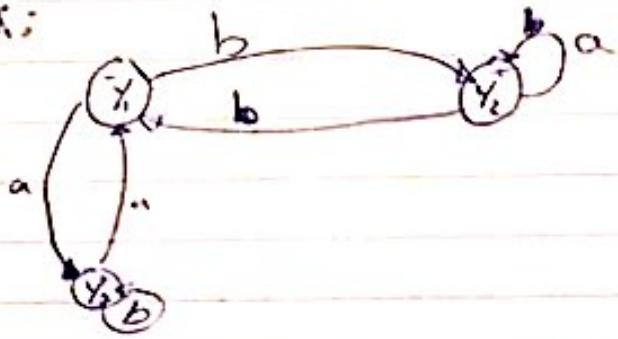
where:

$t(y_1, a) = y_3$, $t(y_1, a) = y_2$, $t(y_3, a) = y_2$

$t(y_1, b) = y_2$, $t(y_2, b) = y_2$, $t(y_3, b) = y_3$

Prove that L' is also regular language by constructing FA

FA:



Assume

$z_1 = y_1$

read a = $y_3 + y_1 \longrightarrow z_2$

read b = $y_2 + y_1 \longrightarrow z_3$

$z_2 = y_3 + y_1$

read a = $y_3 + y_1 \longrightarrow z_2$

read b = $y_3 + y_1 + y_2 \longrightarrow z_4$

$z_3 = y_2 + y_1$

read a = $y_2 + y_1 + y_3 \longrightarrow z_4$

read b = $y_2 + y_1 \longrightarrow z_3$

$z_4 = y_3 + y_1 + y_2$

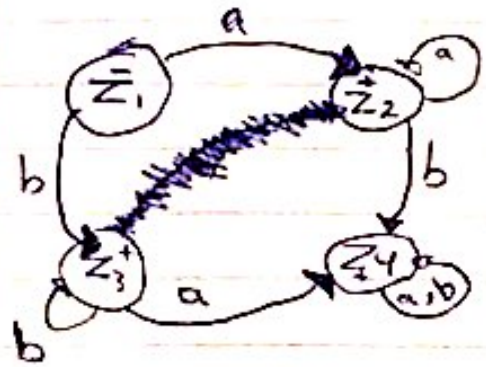
read a = $y_1 + y_3 + y_2 \longrightarrow z_4$

read b = $y_3 + y_2 + y_1 \longrightarrow z_4$

Continue; Create table

	a	b
$-z_1$	z_2	z_3
$+z_2$	z_2	z_4
$+z_3$	z_2	z_3
$+z_4$	z_4	z_4

* to choose start and Final we choose the first thing we started with as a start, and as Final each thing had been including Finals



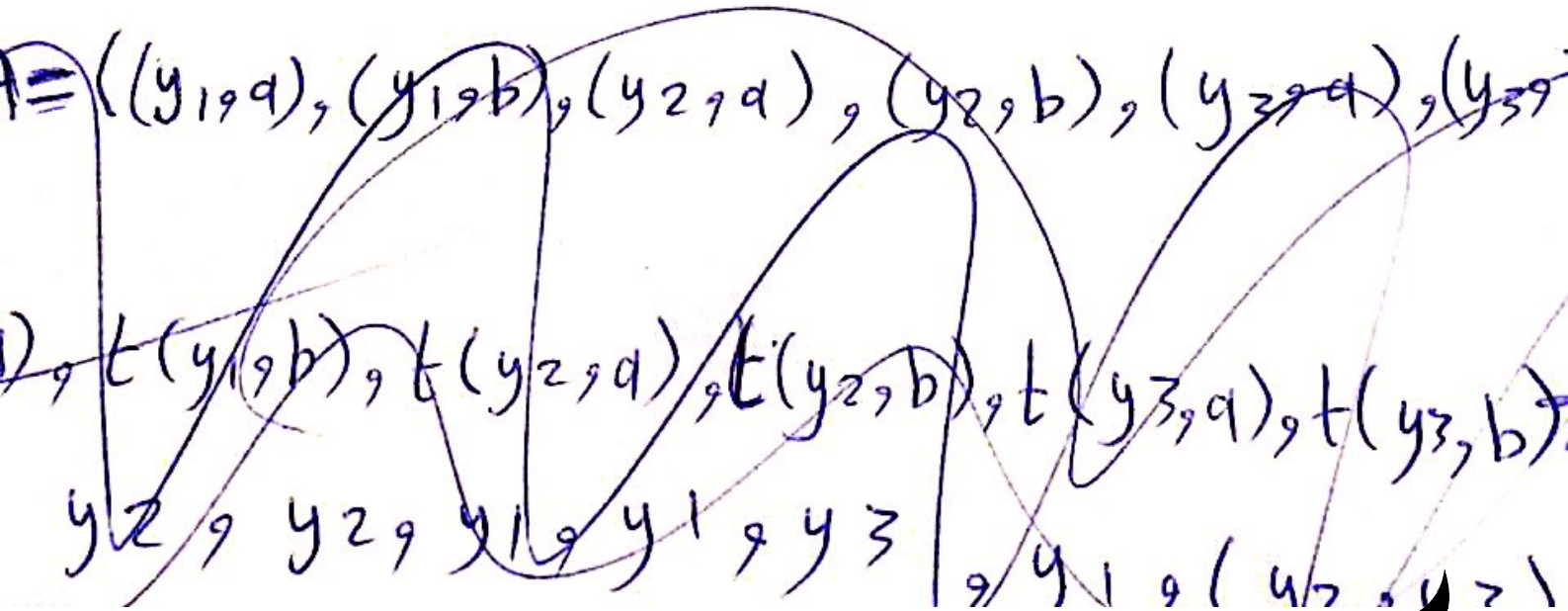
Q3. Give the regular L, that is represented by the following FA: (5 marks)

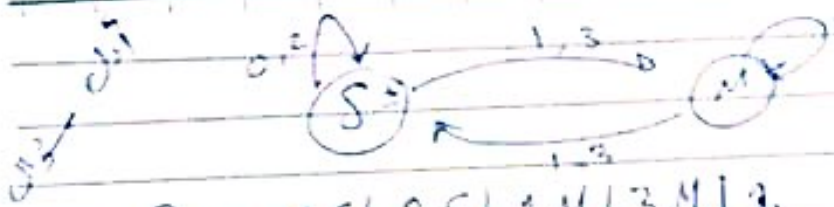
$$FA = (\{ y_1, y_2, y_3 \}, \{ a, b \}, t, y_1, \{ y_2, y_3 \})$$

Where

$t (y_1, a) = y_3$	$t (y_2, a) = y_2$	$t (y_3, a) = y_1$
$t (y_1, b) = y_2$	$t (y_2, b) = y_1$	$t (y_3, b) = y_3$

Prove that L^* is also regular language by constructing FA.





$S \to 0S \mid 2S \mid 1M \mid 3M \mid \lambda$

$M \to 0M \mid 2M \mid 1S \mid SS$

Remove λ

$S \to XZ \mid Y \mid aSa$

$X \to aX \mid abY \mid ab$

$Y \to bYb \mid bY \mid bb \mid b$

Remove unit

$S \to XZ \mid aSa \mid aa \mid bYb \mid bY \mid bb \mid b$

$X \to aX \mid abY \mid ab$

$Y \to bYb \mid bY \mid bb \mid b$

to CNF

$S \to XQ \mid AR_1 \mid AA \mid BR_2 \mid BY \mid b$

$R_1 \to SA$

$R_2 \to YB$

$Q \to$

$A \to a$

$B \to b$

$X \to AX \mid AR_3 \mid AB$

$R_3 \to BY$

$Y \to BR_2 \mid BY \mid BB \mid b$

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

Q2. Consider $\Sigma = \{a, b\}$ find regular expression for the language that each wo
contain triple a. [7 Marks]

Answer

$$(b^* + \lambda)(abb^* + aabb^*)^*(\lambda + a + aa)$$

Q3. Consider $\Sigma = \{a, b\}$ construct a DFA that accept any word start with a a
and the total number of a's are odd. [7 Marks]

Answer

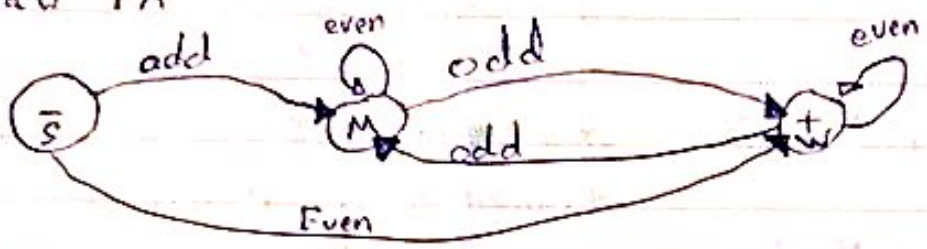
$FA = (\{1, 2, 3\}, \{a, b\}, T1, 1, 3)$

$T1(1, a) = 2$ $T1(2, a) = 1$ $T1(2, b) = 3$
$T1(3, a) = 1$ $T1(3, b) = 3$

Q2 (A) Consider $\Sigma = \{0, 1, 2, 3\}$, Construct CFG that can give any number whose sum of its digits is even.

Solution

draw FA



odd = 1, 3

Even = 0, 2

CFG:

$S \rightarrow 1M \mid 3M \mid 0W \mid 2W$

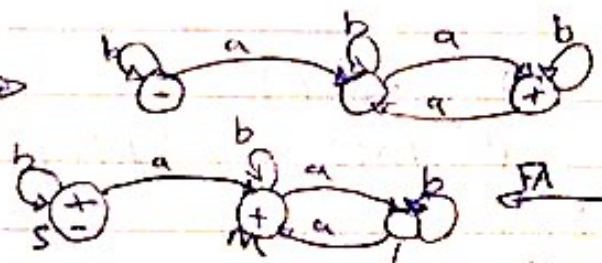
$M \rightarrow 0M \mid 2M \mid 1W \mid 3W$

$W \rightarrow 0W \mid 2W \mid 1M \mid 3M \mid \lambda$

Q2 B Consider $\Sigma = \{a, b\}$ Construct CFG that can generate any word that does Not Contain double a

solution

double a FA →



to Create Not double a FA

→ Make Final state None Final

→ Make None Final into Final

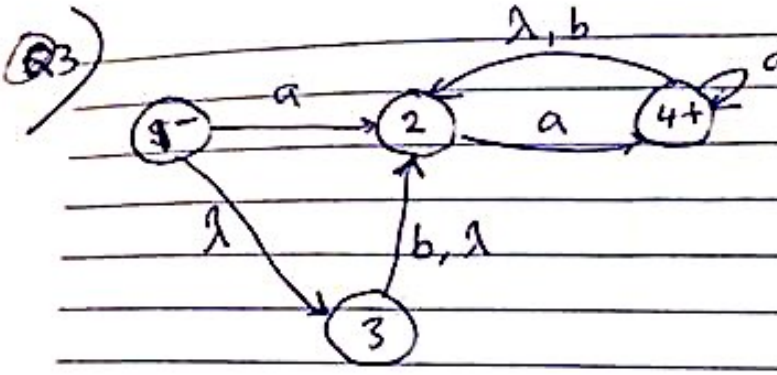
since this is a rejected state i dont have to write it in my CFG

CFG:

$S \rightarrow bS \mid aM \mid \lambda$

$M \rightarrow bM \mid \lambda$

Q3)



Convert the DFA

	a	b
{1,2,3}	{2,4}	{2}
{2}	{2,4}	ϕ
*{2,4}	{2,4}	{2}

$\lambda(1) = \{1,2,3\}$
$\lambda(2) = \{2\}$
$\lambda(3) = \{2,3\}$
$\lambda(4) = \{2,4\}$

start $\lambda(1) = \{1,2,3\}$

$T_D(\{1,2,3\}, a) = \lambda(T_N(1,a) \cup T_N(2,a) \cup T_N(3,a))$

$= \lambda(2 \cup 4 \cup \phi) = \lambda(2,4) = \lambda(2) \cup \lambda(4)$

$= \{2,4\}$

$T_D(\{1,2,3\}, b) = \lambda(T_N(1,b) \cup T_N(2,b) \cup T_N(3,b))$

$= \lambda(\phi \cup \phi \cup 2) = \lambda(2) = \{2\}$

$T_D(\{2\}, a) = \lambda(T_N(2,a)) = \lambda(4) = \{2,4\}$

$T_D(\{2\}, b) = \lambda(T_N(2,b)) = \lambda(\phi) = \phi$

$T_D(\{2,4\}, a) = \lambda(T_N(2,a) \cup T_N(4,a))$

$= \lambda(4 \cup 4) = \lambda(4) = \{2,4\}$

$T_D(\{2,4\}, b) = \lambda(T_N(2,b) \cup T_N(4,b)) = \lambda(\phi \cup 2) = \{2\}$

① RE for L

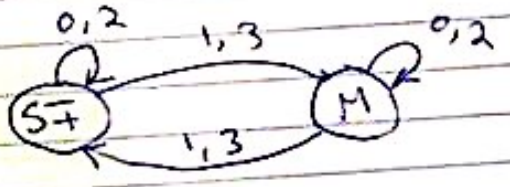
start with double a and end with at least one b and does not contain triple a.

~~(aaab + λ)(ab + aaab)*b*~~

Q6) CFG for L

$\Sigma = \{0, 1, 2, 3\}$

sum of its digits is even



$S \rightarrow 0S \mid 2S \mid \lambda \mid M \mid 3M \mid 1$

$M \rightarrow 0M \mid 2M \mid 1S \mid 3S$

Q6

③ PDA for L

$L = a^n b^{2n}$

Q5) CFL

~~Rt~~ L_1: start with a end with b

CFL L_2: contains double b.

prove

$L_1 L_2$ is CFL.

L_1

$S_1 \rightarrow aM_1b$

$M_1 \rightarrow ~~aab~~ aM_1 \mid bM_1 \mid \lambda$

$S \rightarrow S_1 S_2$

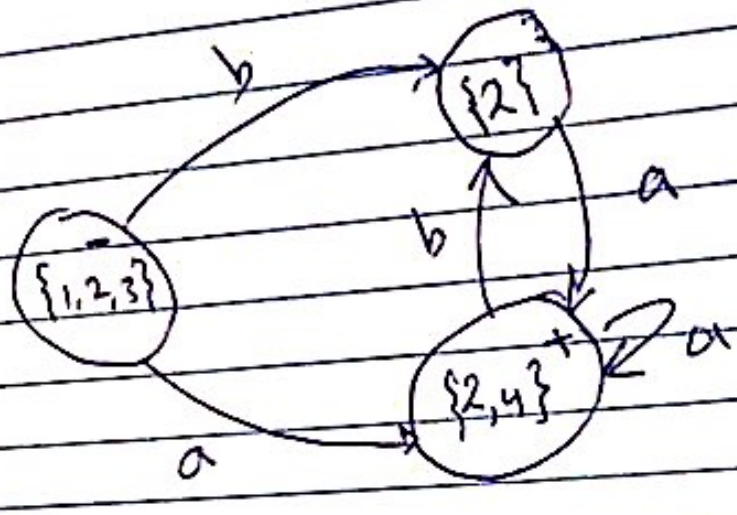
L_2

$S_2 \rightarrow bS_2 \mid aM_2$

$M_2 \rightarrow bS_2 \mid aF_2$

$F_2 \rightarrow aF_2 \mid bF_2 \mid \lambda$

Q5

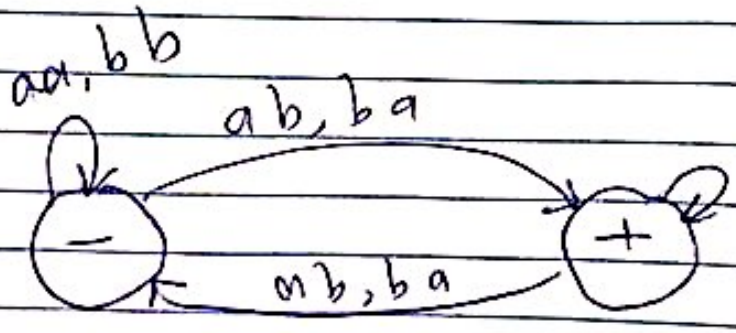


NFA = ({1,2,3}, {a,b}, t, 1, {4})

t(1,a) = 2 t(2,a) = 4
t(1,λ) = 3

t(3,b) = 2 t(4,λ) = 4
t(3,λ) = 2 t(4,b) = 2
t(4,λ) = 2

Q4)



Q4