Decipher 44 final Question
Solve
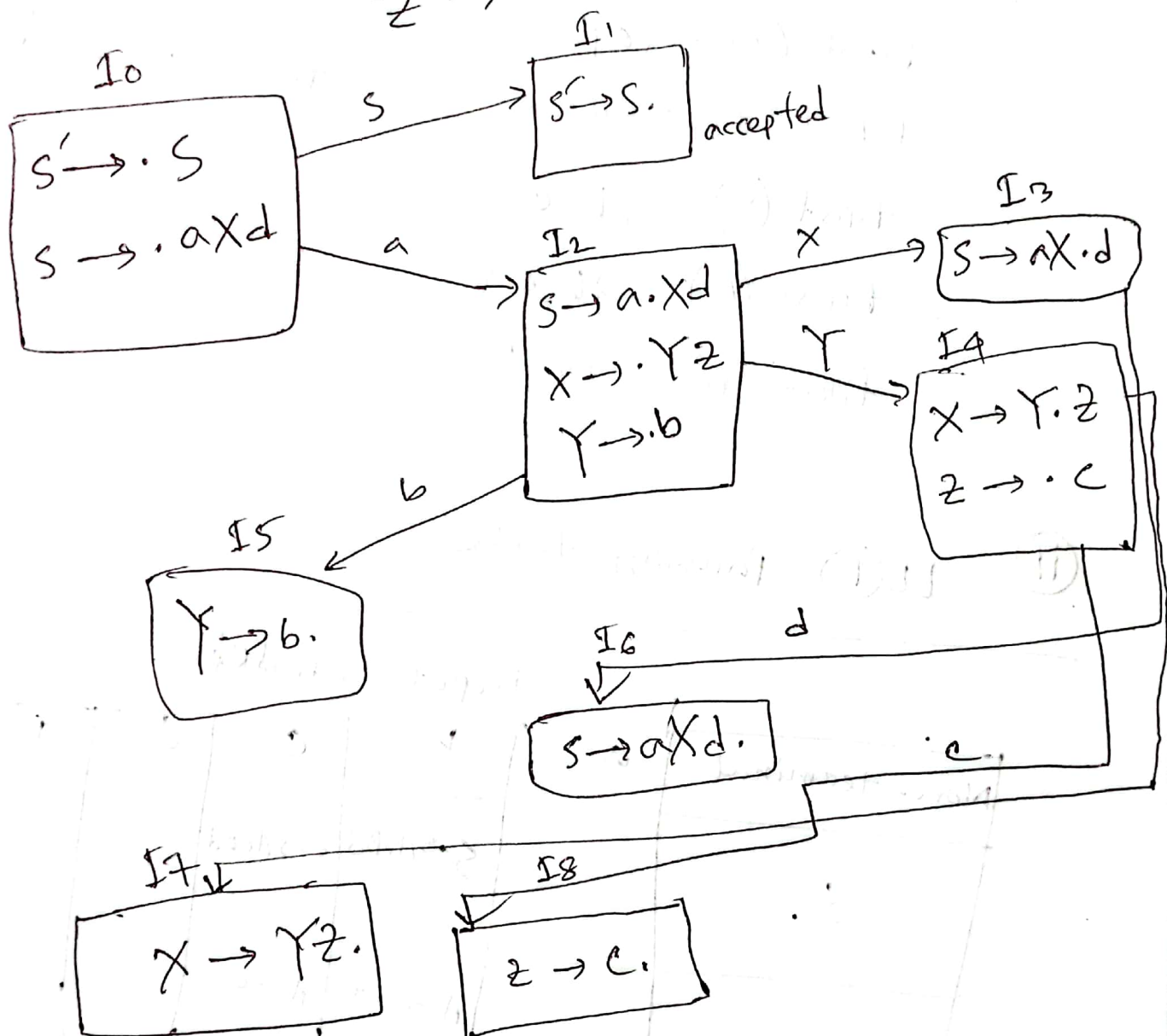
2(a) LR(0) automation for the following grammer

$$S \rightarrow aXd$$
$$X \rightarrow YZ$$
$$Y \rightarrow b$$
$$Z \rightarrow e$$

I_0
$$S' \rightarrow \cdot S$$
$$S \rightarrow \cdot aXd$$

I_1
$$S' \rightarrow S \cdot$$ accepted

I_2
$$S \rightarrow a \cdot Xd$$
$$X \rightarrow \cdot YZ$$
$$Y \rightarrow \cdot b$$

I_3
$$S \rightarrow aX \cdot d$$

I_4
$$X \rightarrow Y \cdot Z$$
$$Z \rightarrow \cdot c$$

I_5
$$Y \rightarrow b \cdot$$

I_6
$$S \rightarrow aXd \cdot$$

I_7
$$X \rightarrow YZ \cdot$$

I_8
$$Z \rightarrow c \cdot$$

transitions: S, a, X, Y, b, d, c

2(b)

$$S \rightarrow AcBd$$
$$A \rightarrow bA \mid \epsilon$$
$$B \rightarrow cBd \mid a$$

(i)

first $(a) = \{a\}$

first $(b) = \{b\}$

first $(c) = \{c\}$

first $(d) = \{d\}$

first $(S) = \{b, c\}$

first $(A) = \{b, \epsilon\}$

first $(B) = \{c, a\}$

follow $(S) = \{\$\}$

follow $(A) = \{c\}$

follow $(B) = \{d\}$

(ii) LL(1) Parsing table

input symbol

Non-terminal	a	b	c	d	$
S.			$S \rightarrow AcBd$ $\quad$ $S \rightarrow AcBd$		
A		$A \rightarrow bA$	$A \rightarrow \epsilon$		
B	$B \rightarrow a$		$B \rightarrow cBd$		

(vii) Predictive Parser on input 'ccad'

method	stack	input	Action
	S$	ccad$	output S→AcBd
	AcBd$	ccad$	output A→ε
	cBd$	ccad$	matched c
c	Bd$	cad$	output B→cBd
c	cBdd$	cad$	matched c
cc	Bdd$	ad$	output B→a
ec	add$	ad$	matched a
cca	dd$	d$	matched d
ccad	d$	$	error
ccad	d$	$	

2(c)

$$S \rightarrow ASA \mid aB$$
$$A \rightarrow B \mid S$$
$$B \rightarrow b \mid \epsilon$$

Step-1 : Remove ϵ-production :

here, $B \rightarrow \epsilon$

so, $A \rightarrow \epsilon$

After $B \rightarrow \epsilon$

$$S \rightarrow ASA \mid aB \mid a$$
$$A \rightarrow B \mid S \mid \epsilon$$
$$B \rightarrow b$$

After $A \rightarrow \epsilon$

$$S \rightarrow ASA \mid aB \mid a \mid SA \mid AS \mid S$$
$$A \rightarrow B \mid S \mid \cancel{\epsilon}$$
$$B \rightarrow b$$

Step-2 : Unit production remove:

$$S \rightarrow ASA \mid aB \mid a \mid SA \mid AS \mid s$$
$$A \rightarrow B \mid S$$
$$B \rightarrow b$$

Unit pair,

$(S, s), (A, A), (B, B)$

$(S, s) :$ $S \longrightarrow s$ $: (S, s)$

$(A, A) :$ $A \longrightarrow B$ $: (A, B)$

$(A, B) :$

$(A, A) :$ $A \longrightarrow s$ $: (A, s)$

$(A, s) :$ $S \longrightarrow s$ $: (A, s)$

$(B, B) :$

Pair	Production
(S, s)	$S \rightarrow ASA \mid aB \mid a \mid AS \mid SA \mid$
(A, A)	$A \rightarrow$
(B, B)	$B \rightarrow b$
(A, B)	$A \rightarrow b$
(A, s)	$A \rightarrow ASA \mid aB \mid A \mid AS \mid SA$

$S \rightarrow ASA \mid aB \mid a \mid AS \mid SA$

$A \rightarrow b \mid ASA \mid aB \mid a \mid AS \mid SA$

$B \rightarrow b$

Step-3 : Remove useless symbol

$S \rightarrow ASA \mid aB \mid a \mid AS \mid SA$

$A \rightarrow b \mid ASA \mid aB \mid a \mid AS \mid SA$

$B \rightarrow b$

Useful : $\{a, b, A, B, S\}$

Here, we can see that every terminal &

non- terminal are generating and also

reachable.

Step- 4 :

let, $X \rightarrow SA$

$Y \rightarrow a$

$S \rightarrow AX \mid YB \mid a \mid AS \mid SA$

$A \rightarrow b \mid AX \mid YB \mid a \mid AS \mid SA$

$B \rightarrow b$

3(a)

E-NFA to DFA

	ϵ	a	b
→ *1	{3}	$\emptyset$	{2}
2	$\emptyset$	{2,3}	{3}
3	$\emptyset$	{2,3}	$\emptyset$
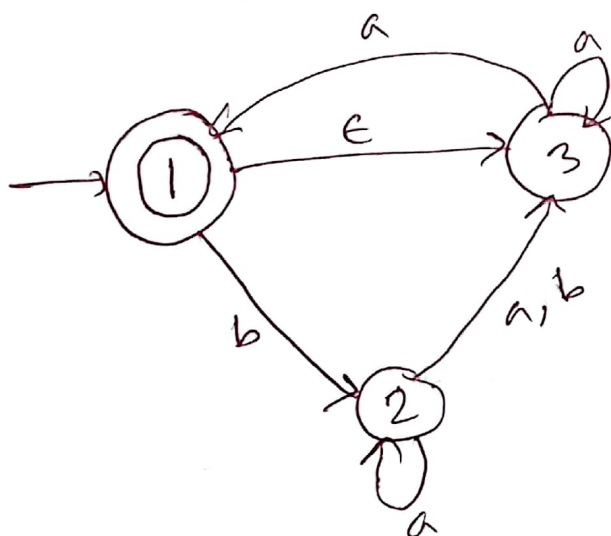
ϵ-closure (1) : {1,3}

ϵ-closure (2) : {2}

ϵ-closure (3) : {3}
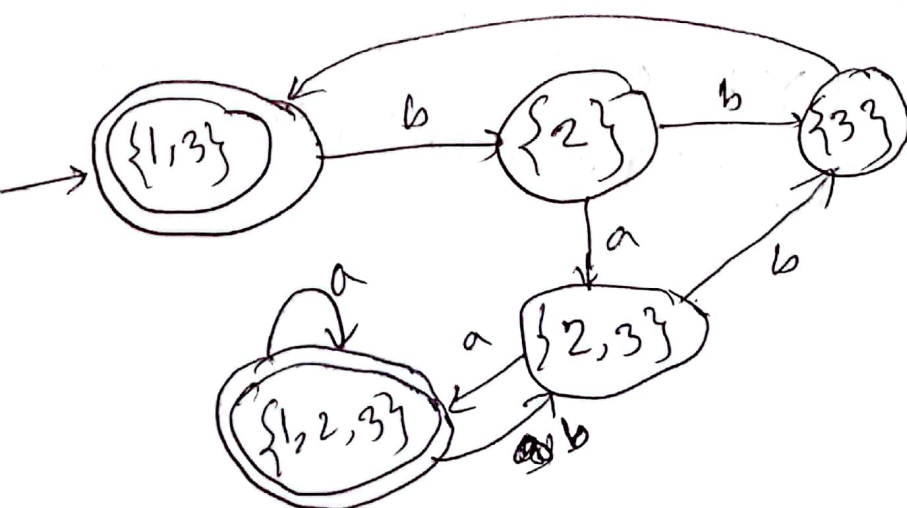
	ϵ	a	b
→ {1,3}	{3}	$\emptyset$	{2}
{2}	$\emptyset$	{2,3}	{3}
{3}	$\emptyset$	{1,3}	$\emptyset$
{2,3}	$\emptyset$	{1,2,3}	{3}
*{1,2,3}	{3}	{2,3}	{2,3}

Minimization of DFA

	0	1
→ a	c	b
* b	d	d
c	a	b
* d	d	d
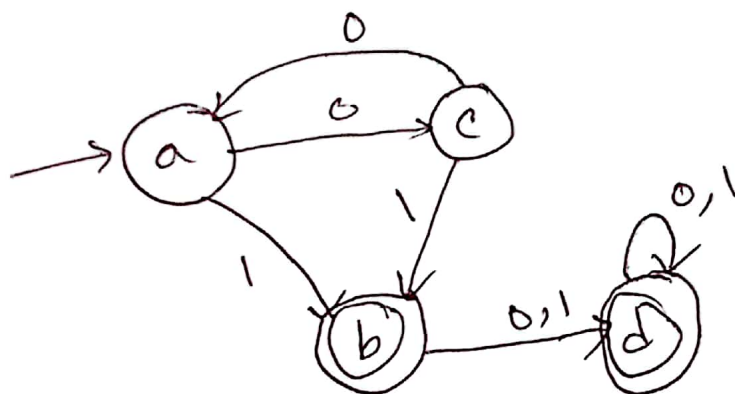
0 eq :   {a, c} , {b, d}

~~1 eq : {a}, {c}, {b, d}~~

1 eq : {a, c}, {b, d}

3(e)

$$S \rightarrow (L) | a$$
$$L \rightarrow L, s | s.$$

form

$$A \rightarrow A\alpha | \beta$$

let,

$$A = L$$
$$A' = L'$$

$$A \rightarrow \beta A'$$
$$A' \rightarrow \epsilon | \alpha A'$$
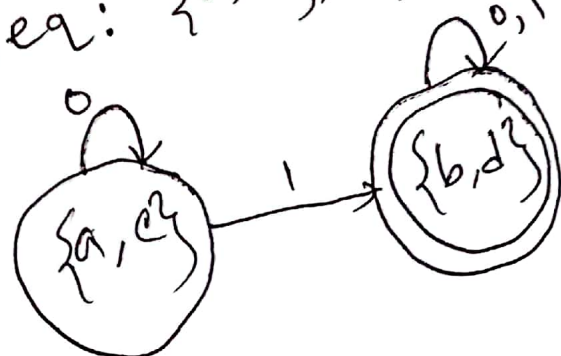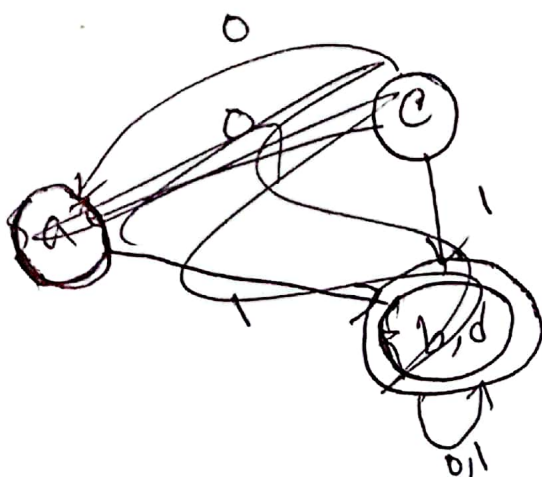
$$L \rightarrow \beta L'$$
$$L' \rightarrow \epsilon | \alpha L'$$

here,

$$\alpha = , s$$

$$\beta = s$$

$$S \rightarrow (L) | ^,$$

so, $$L \Rightarrow sL'$$

$$L' \rightarrow \epsilon | , sL'$$

3(d)

moves of an LR Parser on id + id

$$E \rightarrow E+T \mid T$$
$$T \rightarrow T*F \mid F$$
$$F \rightarrow (E) \mid id$$

Line	Stack	Symbol	Input	Action
0	0	$	id+id $	shift to 5
1	0 5	$ id	+id $	Reduced by F→id
2	0 3	$ F	+id $	Reduced by T→F
3	0 2	$ T	+id $	Reduced by E→t
4	0 1	$ E	+id $	shift to 6
5	0 1 6	$ E+	id $	shift to 5
6	0 1 6 5	$ E+id	$	Reduced by F→id
7	0 1 6 3	$ E+F	$	Reduced by T→F
8	0 1 6 9	$ E+T	$	Reduced by E→E+T
9	0 1	$ E	$	Accept
10	0 1			

4 (a)

① $\langle exp \rangle \rightarrow \langle exp \rangle \langle op \rangle \langle exp \rangle \mid (\langle exp \rangle) \mid a \mid b \mid c$

② $\langle op \rangle \rightarrow < \mid > \mid \le \mid > = \mid + \mid -$

Proof :

$$\langle exp \rangle \rightarrow \langle exp \rangle \langle op \rangle \langle exp \rangle$$

$$\rightarrow (\langle exp \rangle) \langle op \rangle \langle exp \rangle$$

$$\rightarrow (\langle exp \rangle \langle op \rangle \langle exp \rangle) \langle op \rangle \langle exp \rangle$$

$$\rightarrow (a \langle op \rangle \langle exp \rangle) \langle op \rangle \langle exp \rangle$$

$$\rightarrow (a + b) < c$$

4 (b)

① $0 (1 + \epsilon)(0 + 01)^* + 0 (0 + 01)^* (1 + \epsilon)$

~~$0 (0 + 01)^* (1 + \epsilon)$~~

② $(01)^* + (10)^*$

③ $0^* \left(1^* (00^+ + \epsilon) 1^* \right)^* 0^*$

4(c)

$$0, Z_0 / 0 Z_0$$
$$1, Z_0 / 1 Z_0$$
$$0, 0 / 0 0$$
$$0, 1 / 0 1$$
$$1, 0 / 1 0$$
$$1, 1 / 1 1$$

$$0, 0 / \epsilon$$
$$1, 1 / \epsilon$$

$$\rightarrow q_0$$

$$\epsilon, Z_0 / Z_0$$
$$0, 0 / 0$$
$$0, 1 / 1$$

$$q_1$$

$$\epsilon, Z_0 / Z_0$$
$$1, 0 / 0$$
$$1, 1 / 1$$

$$q_2$$

$$\epsilon, Z_0 / Z_0$$

$$q_3$$
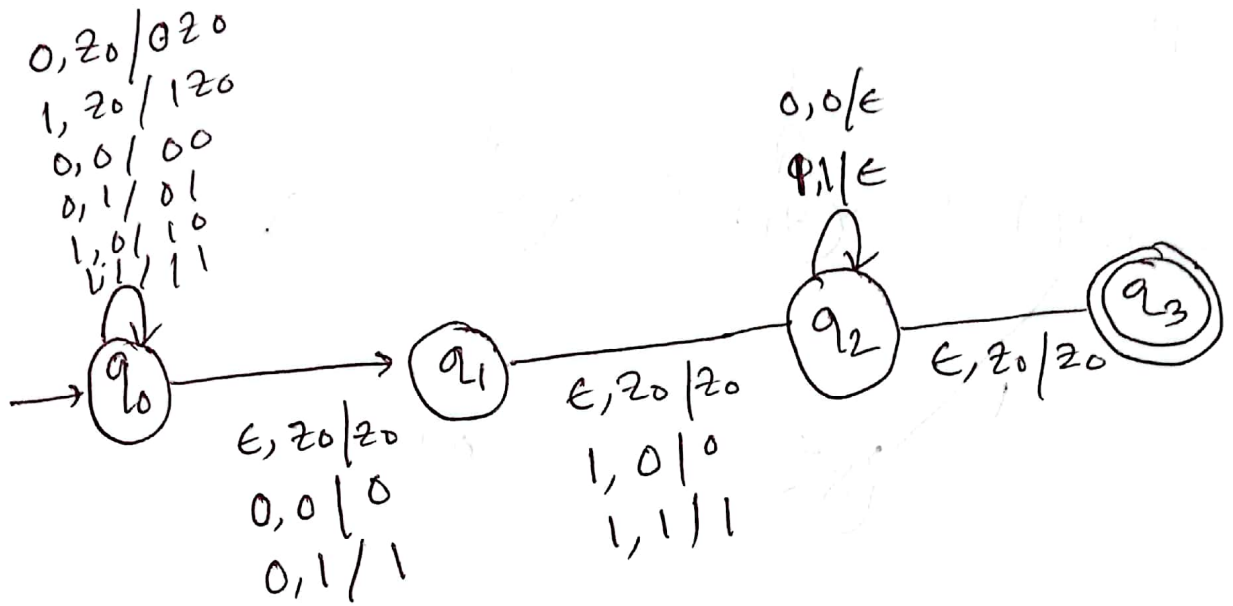
Showing the moves of 100101 :
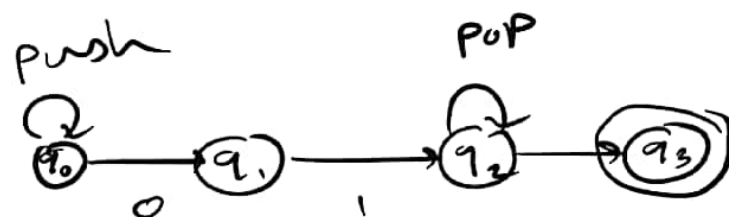
push   PoP 100101

$(q_0, 100101, Z_0)$

$\downarrow$

$(q_0, 00101, 1Z_0) \longrightarrow$

$(q_0, 0101, 01Z_0) \longrightarrow$ $(q_1, 0101, 1Z_0)$

$\downarrow$

$(q_0, 101, 001Z_0)$ $(q_1, 101, 01Z_0) \rightarrow (q_2, 01, 01Z_0) \rightarrow (q_2, 1, 1Z_0)$

$\downarrow$ $\downarrow$

$(q_0, 01, 1001Z_0) \longrightarrow (q_1, 1, 1001Z_0) \rightarrow (q_2, \varepsilon, 1001Z_0)$ (q_2, ε, Z_0)

$\downarrow$ $\downarrow$

$(q_0, 1, 01001Z_0)$ (q_3, ε, Z_0)

$\downarrow$

$(q_0, \varepsilon, 101001Z_0$
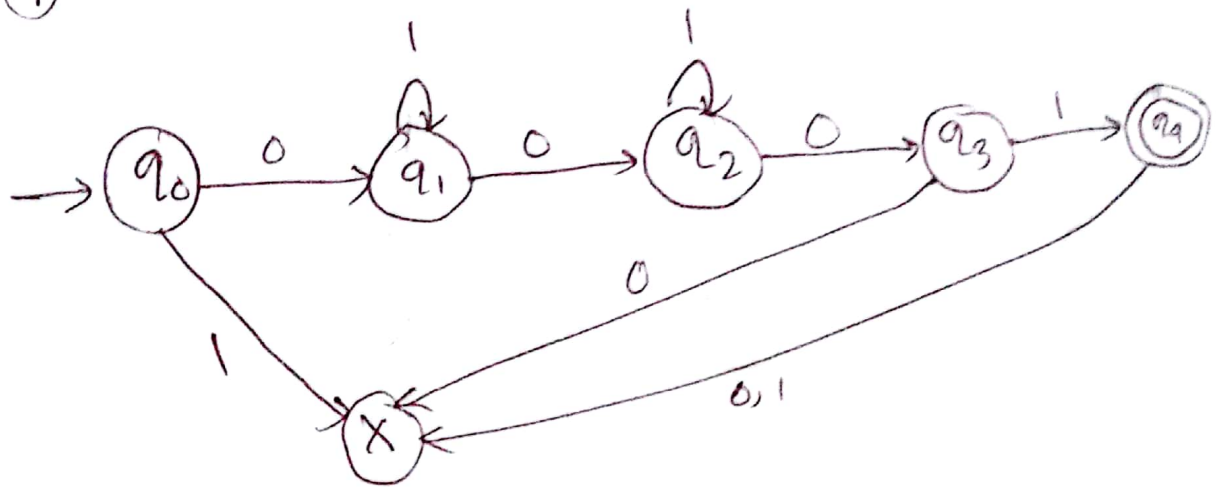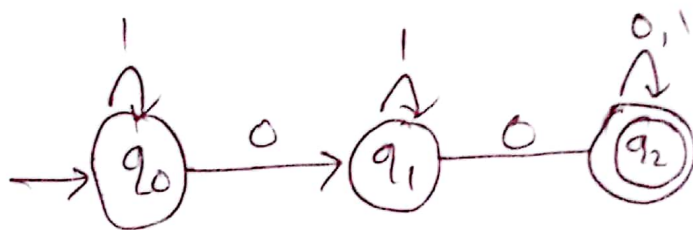
(i)

(ii)

4(e)

$b = 3$

$t_1 = b * 3$

$t_2 = 1 + t_1$

$a = t_2$

if $a > b$ goto A

goto B

A: $t_1 = a - 2$

$a = t_1$

loop: if $a > b$ goto e

goto B

C: $t_1 = a + b$

$b = t_1$

param b

call funcl, 1

$t_1 = a - 1$

$a = t_1$

goto loop

B: if $b = 1$ goto D

if $b = 2$ goto E

goto F

D: $t = a - 1$

$a = t$

goto G

E: $t_1 = -a$

$t_2 = t_1 * 3$

$t_3 = t_2 + 5$

goto G

F: $a = 0$

G: End