

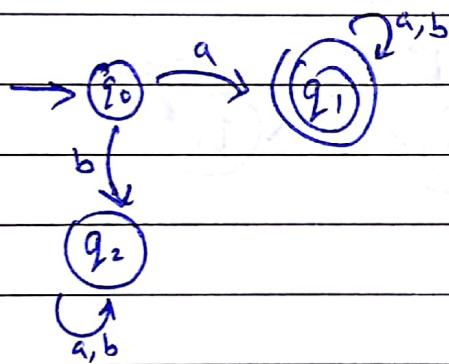
Q1. (a) $L_1 = \{ab, bc\}$ $L_2 = \{a, b, ab, aa, ba, bb\}$

(b) $L_1 \cup L_2 = \{ab, bc, a, b, aa, ba, bb\}$

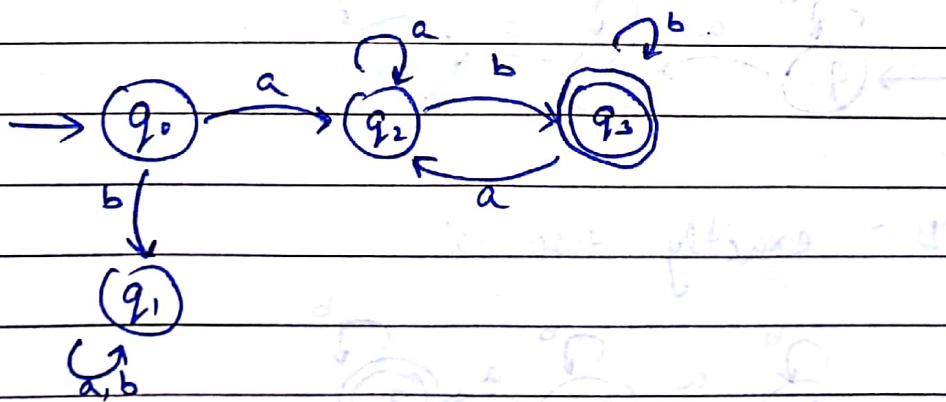
(c) $L_1 \cdot L_2 = \{aba, abb, abab, abaa, abba, abbba, bca, bcb, bcab, bcaa, bcba, bcbbb\}$

(d) $L_1^* = \{\epsilon, ab, bc, abbc, abab, brab, bcbc, ababab, \dots\}$

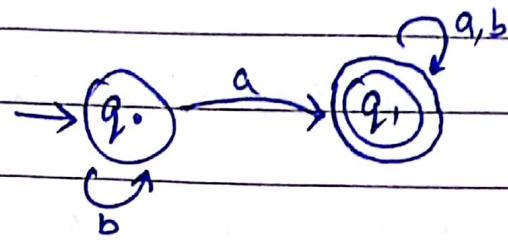
Q3. (a) $\Sigma = \{a, b\}$ $L = \text{start with } a$



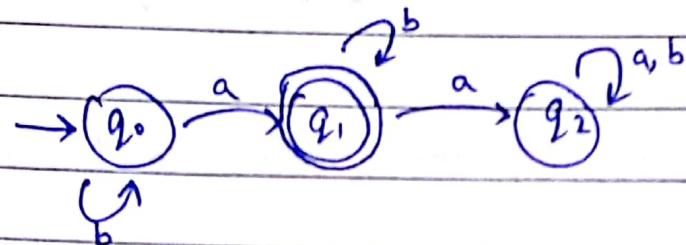
(b) $L = \text{start with 'a', end with 'ba'}$



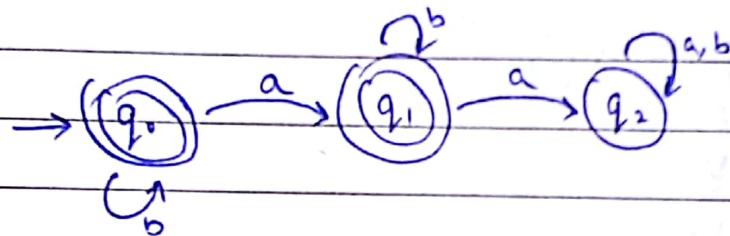
(c) $L = \text{at least one 'a'}$



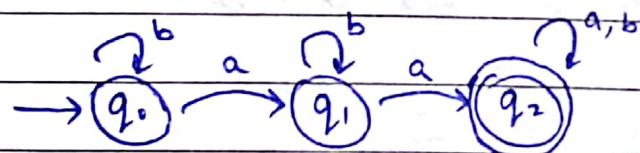
(d) $L = \text{exactly one 'a'}$



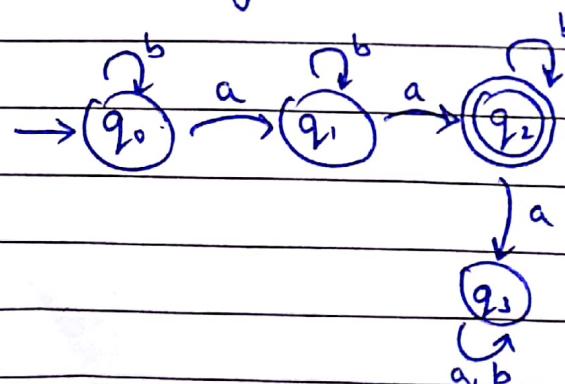
(e) $L = \text{at most one 'a'}$



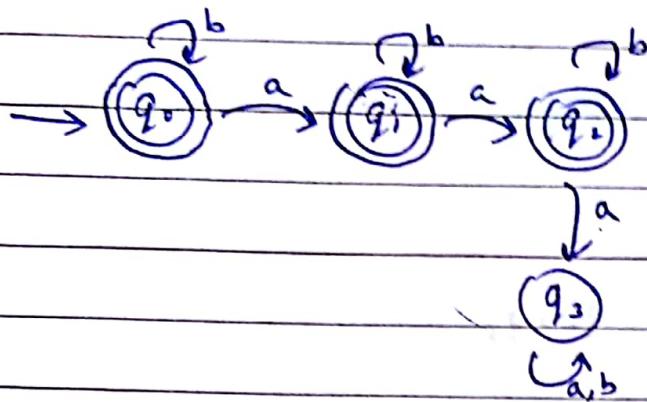
(f) $L = \text{at least two 'a'}$



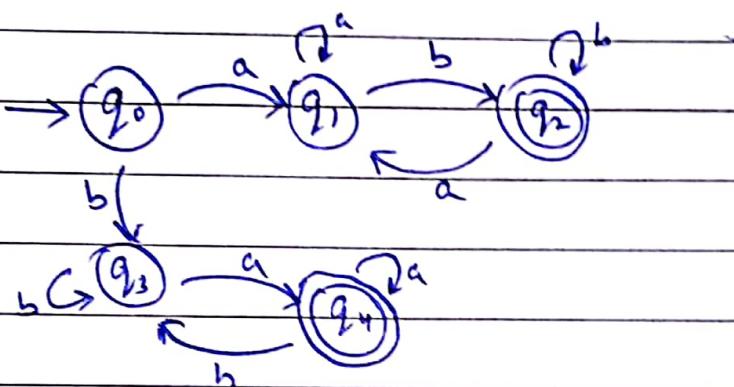
(g) $L = \text{exactly two 'a'}$



(h) $L = \text{at most two 'a'}$



(i) $L = \text{start and end letter different}$



Q2. (a) $a a^* b^*$

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

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

(d) $b^* a b^*$

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

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

(g) $b^* a b^* a b^*$

(h) Problem can be broken in
three parts: 0, 1, 2 'a'

$b^* + b^* a b^* + b^* a b^* a b^*$

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

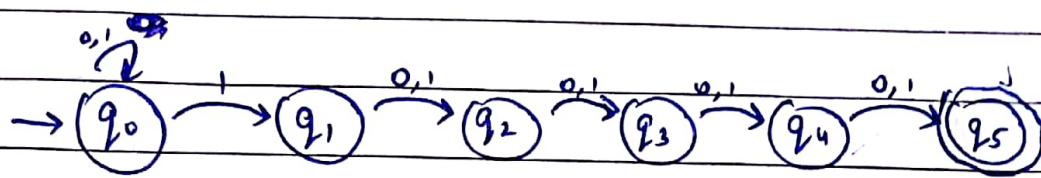
Q. convert NDFA to DFA?

<u>state</u>	<u>a</u>	<u>b</u>
$\rightarrow (q_0)$	q_1, q_2	-
(q_1)	q_1, q_3, q_2	-
q_2	q_3	q_1, q_3
q_3	q_2	-

TUT - 2

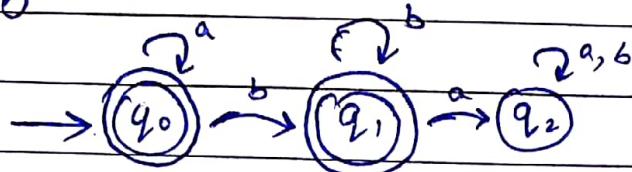
Q8.

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



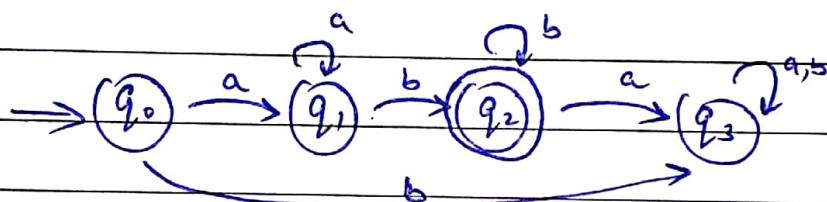
Q9.

$$a^* b^*$$



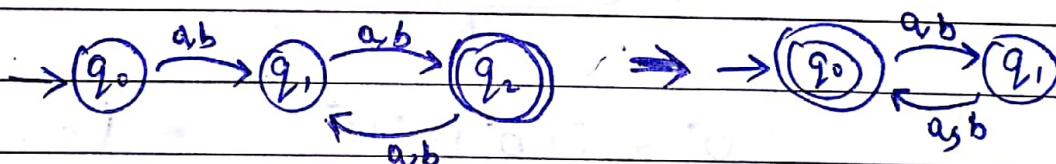
Q6.

$$a \cdot a^* \cdot b \cdot b^*$$



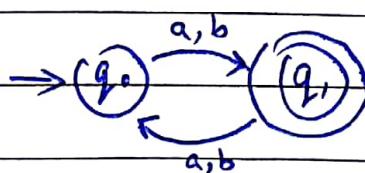
Q5.

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



Q4.

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



Q. 3.

Q. 2.

Q. 1.



$$(0^* + (10^*10^*1)^*)^* = (0 + 10^*10^*1)^*$$

TUT-3

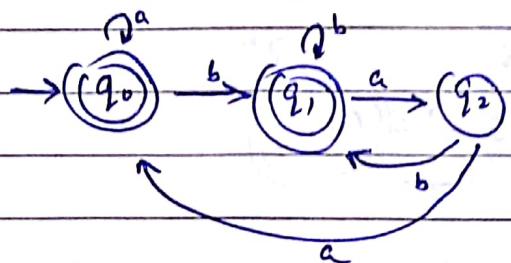
Q1.

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

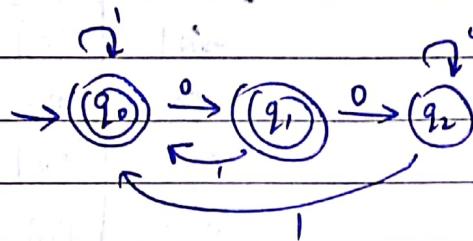
$$= (a+b)^*(aa + ab + bb)$$



	a	b	a'
q0	q0	q1	q0, q1
q1	q1	q2	-
q2	-	-	-



Q2.



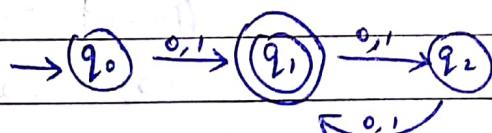
Q6.

$$(a) 1^* (01)^* 0^* - 001$$

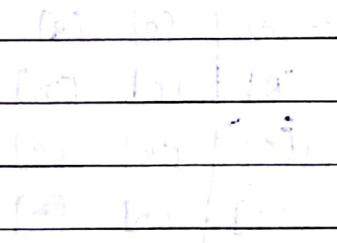
$$(b) 1^* (0+10)^* 1^* - 0110$$

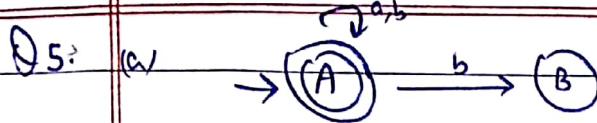
$$(c) 1^* (0^* + 1^*) (0^* + 1^*) (0^* + 1^*) - 0101$$

Q3.



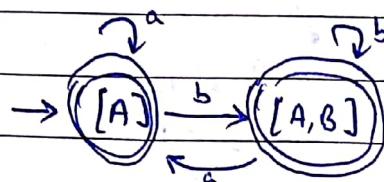
Q4.





NFA initial state

	a	b	DFA initial	a	b
$\rightarrow A$	A	AB	$\rightarrow [A]$	[A]	[A, B]
B	-	-	$([A, B])$	[A]	[A, B]



(b)

	initial	a	b	initial	a	b
$\rightarrow A$	B	-		$\rightarrow [A]$	[B]	[E]
B	B	B, C		$[B]$	[B]	[B, C]
\circled{C}	-	D		$([B, C])$	[B]	[B, C, D]
\circled{D}	-	-		$([B, C, D])$	[B]	[B, C, D]
				$[E]$	[E]	[E]

(c)

	initial	a	b	initial	a	b
$\rightarrow A$	B	-		$\rightarrow [A]$	[B]	[D]
B	B	B, C		$[B]$	[B]	[B, C]
\circled{C}	-	-		$([B, C])$	[B]	[B, C]
				$[D]$	[D]	[D]

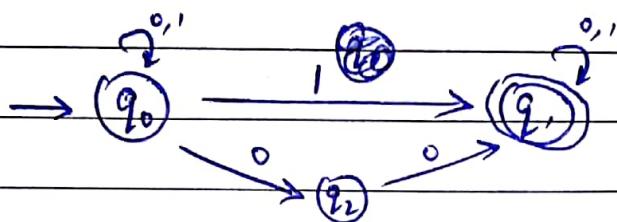
(d)

	initial	a	b	initial	a	b
$\rightarrow A$	B	B		$\rightarrow [A]$	[B]	[B]
B	C	-		$[B]$	[C]	[D]
\circled{C}	B	B		$([C])$	[B]	[B]
				$[D]$	[D]	[D]

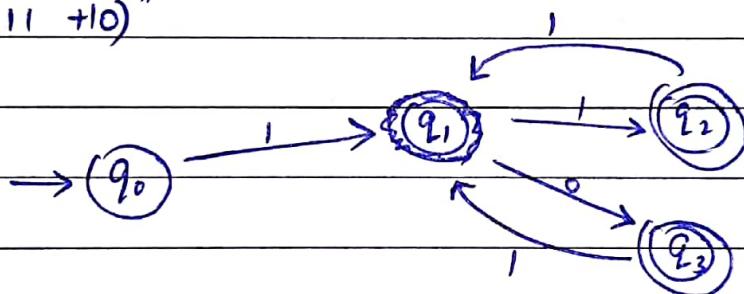
Initial		a	b
→ A		A, C	B
B		C	-
C		C	-

Initial		a	b
→ [A]		[A, C]	[B]
[B]		[C]	[D]
[A, C]		[A, C]	[B]
[C]		[C]	[D]
[D]		[D]	[D]
[A, C, B]		[A, C]	[B]
[C, D]		[C]	[D]
[D, D]		[D]	[D]
[A, C, B, C, D, D]			

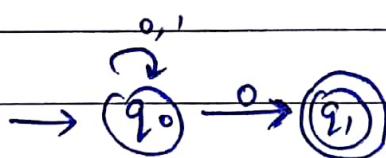
Q7. (a) $(0+1)^* (1+00)(0+1)^*$



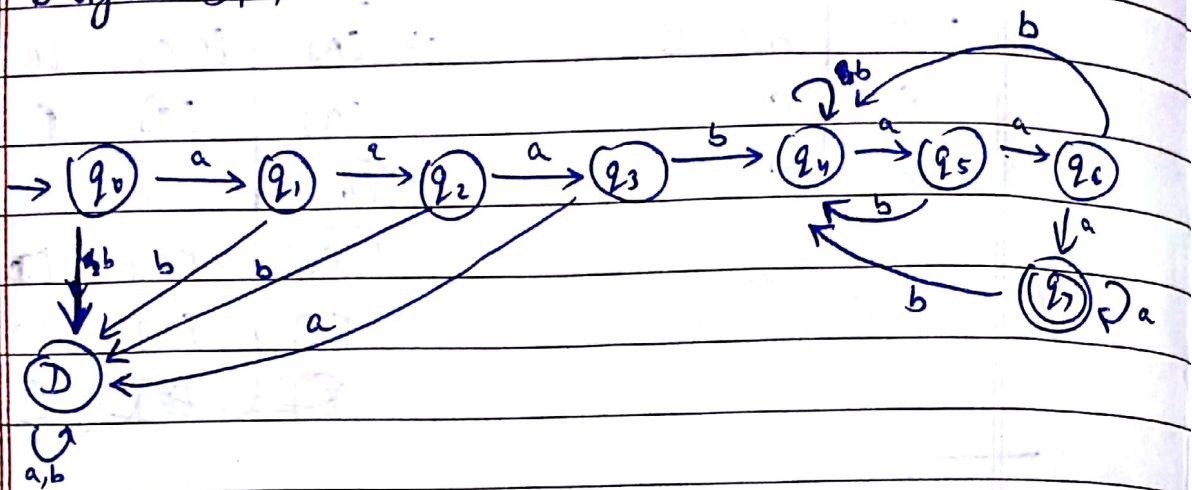
(b) $(11+10)^*$



(c) $(0+1)^* 0$



Q. Design DFA $a^2bw^a^3$ $w = \{a, b\}^*$



T-4

Q.T. (a) no/s	state	I/P a		I/P b		$A \rightarrow A_0$
		state o/p	state o/p	state o/p	state o/p	
	$\rightarrow A$	A	0	B	1	
	B	B	1	C	0	$B \rightarrow B$
	C	C	0	A	1	$C \rightarrow C$

no/s	state	I/P a		I/P b		
		state o/p	state o/p	state o/p	state o/p	
	A_0	A_0	0	B	1	
	A_1	A_0	0	B	1	
	B	B	1	C	0	
	C	C	0	A	1	

no/s	state	I/P a		I/P b		o/r
		state o/p	state o/p	state o/p	state o/p	
	$\rightarrow A_0$	A_0		B	0	
	A_1	A_0		B	1	
	B	B		C	1	
	C	C		A	0	

no/s	state	I/P a		I/P b		$A \rightarrow A$
		state o/p	state o/p	state o/p	state o/p	
	$\rightarrow A$	B	0	B	0	$B \rightarrow B$
	B	B	0	B	1	$B \rightarrow B$

state	I/P a		I/P b		o/r
	state o/p	state o/p	state o/p	state o/p	
$\rightarrow A$	B_0	0	B_0	0	
B_0	B_0	0	B_1	1	
B_1	B_0	0	B_1	1	

state	I/P a		I/P b		o/r
	state o/p	state o/p	state o/p	state o/p	
$\rightarrow A$	B_0		B_0		0
B_0	B_0		B_1		0
B_1	B_0		B_1		1

Q6.

state	a	b	o/p
$\rightarrow A$	B	C	0
B	D	C	1
C	C	D	0
D	D	D	1

meals

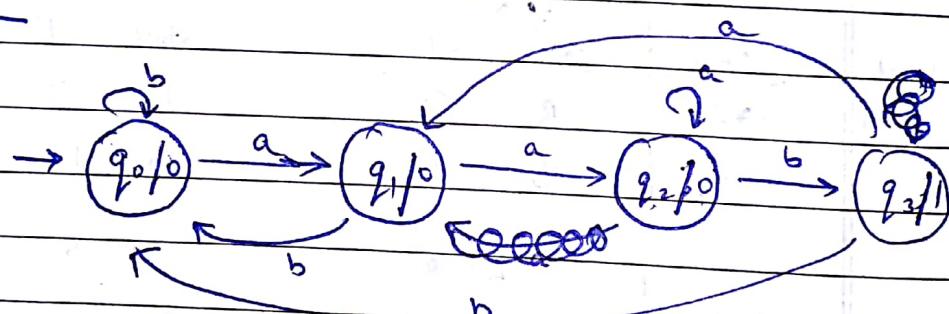
State	I/P a		I/P b	
	state o/p	state o/p	state o/p	state o/p
$\rightarrow A$	B	1	C	0
B	D	1	C	0
C	C	0	D	1
D	D	1	D	1

(b)

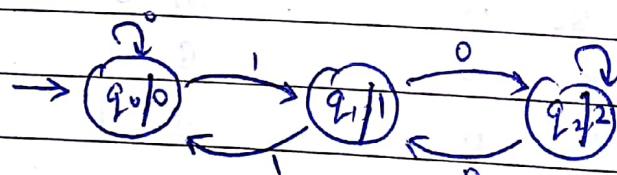
state	a	b	o/p
$\rightarrow A$	B	B	0
B	A	A	1

state	I/P a		I/P b	
	state o/p	state o/p	state o/p	state o/p
$\rightarrow A$	B	1	B	1
B	A	0	A	0

Q1.

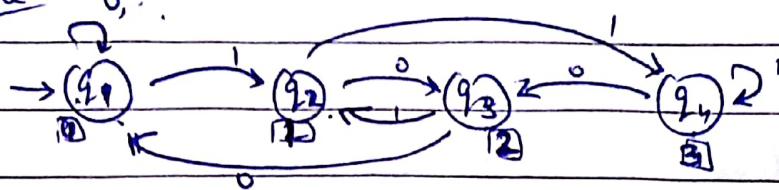


Q2.



Q3.

Moore



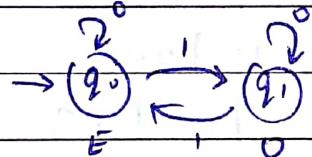
state	I/P 0	I/P 1	O/P
$\rightarrow q_1$	q_1	q_2	0
q_2	q_3	q_4	1
q_3	q_1	q_2	2
q_4	q_2	q_4	3

Mealy

state	I/P 0		I/P 1	
	state	O/P	state	O/P
$\rightarrow q_1$	q_1	0	q_2	2
q_2	q_1	2	q_4	3
q_3	q_1	0	q_2	1
q_4	q_3	2	q_4	3

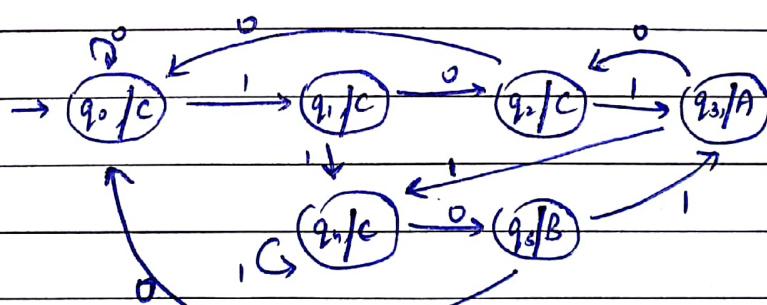
Q4.

Moore



Q5.

Moore



TUT-5

Q5. right-linear

$$S \rightarrow aS$$

$$S \rightarrow bS$$

$$S \rightarrow a \mid b$$

Left-linear -

Q1.

Q6. Right-linear -

$$S \rightarrow 1S$$

$$S \rightarrow 0A$$

$$A \rightarrow 1S$$

$$A \rightarrow 0B$$

$$B \rightarrow 1C \mid 0B$$

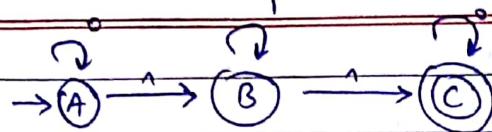
$$C \rightarrow e \mid 0C \mid 1C$$

Left-linear -

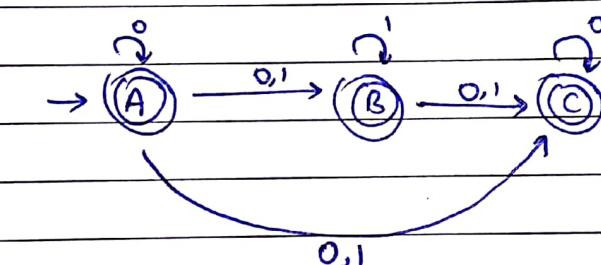
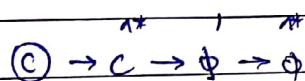
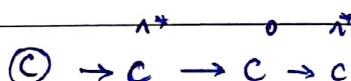
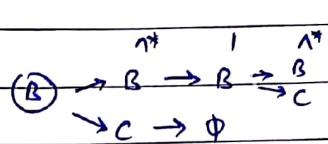
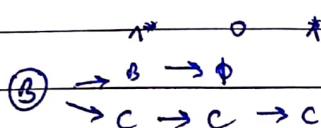
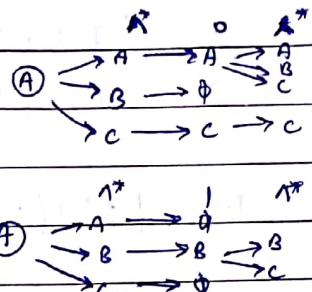
Q4.

Q5.

Q1.



state	0	1
$\rightarrow (A)$	$\{A, B, C\}$	$\{B, C\}$
(B)	$\{C\}$	$\{B, C\}$
(C)	$\{C\}$	\emptyset



$$Q4. A = \epsilon + A \cdot 0 + C \cdot 0 + D \cdot 0 \quad \text{--- (1)}$$

$$B = B \cdot 1 + A \cdot 1 + D \cdot 1 \quad \text{--- (2)}$$

$$C = B \cdot 0 \quad \text{--- (3)}$$

$$D = C \cdot 1 \quad \text{--- (4)}$$

$$(1, 2) \Rightarrow A = \epsilon + A \cdot 0 + B \cdot 0 \cdot 0 + D \cdot 0$$

$$A = (\epsilon + B \cdot 0 \cdot 0 + D \cdot 0)^* 0^* \quad \text{--- (5)}$$

$$(2, 3) \Rightarrow B = B \cdot 1 + (\epsilon + R \cdot 0 \cdot 0 + D \cdot 0) 0^* 1 + D \cdot 1$$

$$B = B \cdot 1 + \epsilon \cdot 0^* 1 + B \cdot 0 \cdot 0 \cdot 0^* 1 + D \cdot 0 \cdot 0^* 1 + D \cdot 1$$

$$B = (0^* \cdot 1 + D \cdot 0 \cdot 0^* \cdot 1 + D \cdot 1) (1 + 0 \cdot 0 \cdot 0^* \cdot 1)^* \quad \text{--- (6)}$$

$$③ ④, ⑥ \Rightarrow D = C \cdot 1$$

$$D = B \cdot 0 \cdot 1$$

$$D = (D \cdot 1 + D \cdot 0 \cdot 0^* \cdot 1 + 0^* \cdot 1) (1 + 0 \cdot 0 \cdot 0^* \cdot 1)^* \cdot 0 \cdot 1$$

$$D = 0^* \cdot 1 (1 + 0 \cdot 0 \cdot 0^* \cdot 1)^* \cdot 0 \cdot 1 + D \left[(1 + 0 \cdot 0^* \cdot 1 \cdot \frac{1}{1+0 \cdot 0 \cdot 0^* \cdot 1}) \right] (1 + 0 \cdot 0 \cdot 0^* \cdot 1)^* \cdot 0 \cdot 1$$

$$D = [0^* \cdot 1 (1 + 0 \cdot 0 \cdot 0^* \cdot 1)^* \cdot 0 \cdot 1] [(1 + 0 \cdot 0^* \cdot 1) (1 + 0 \cdot 0 \cdot 0^* \cdot 1)^* \cdot 0 \cdot 1]^*$$