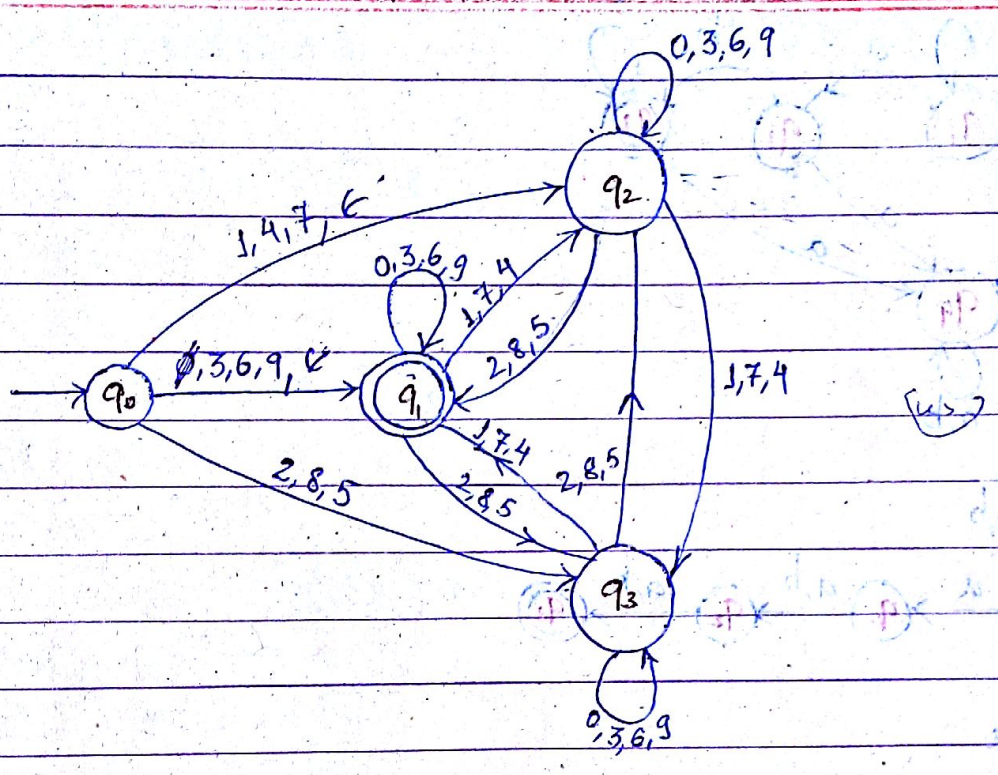
ASSIGNMENT - 1

1.



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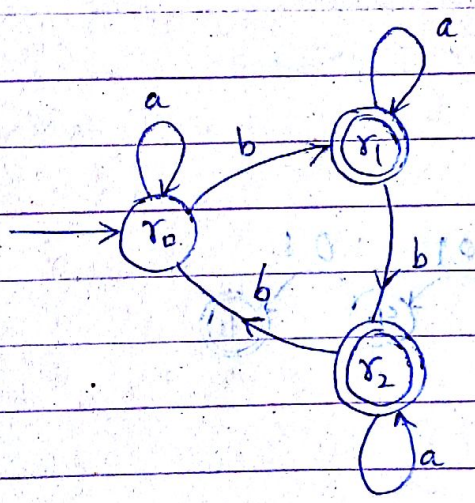

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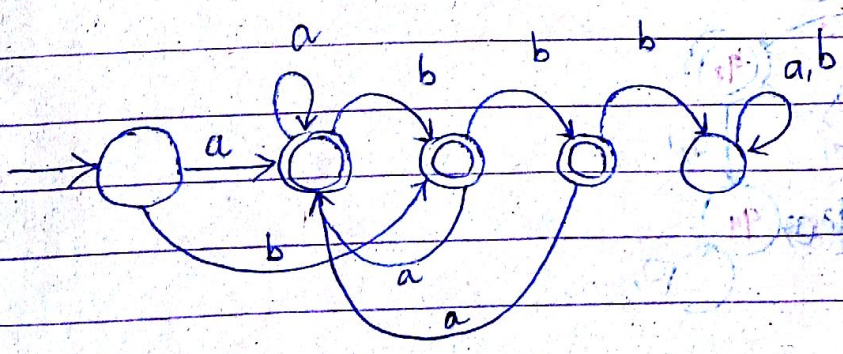

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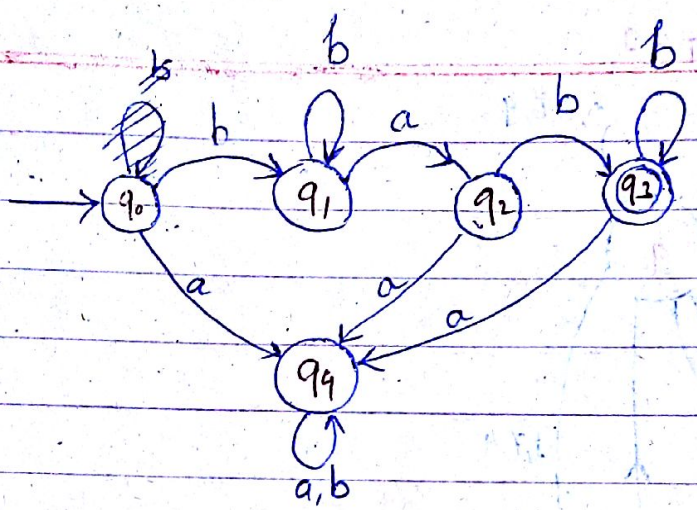

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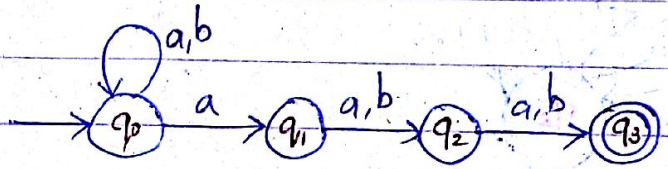

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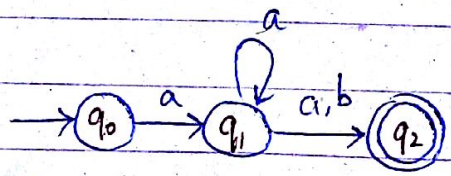

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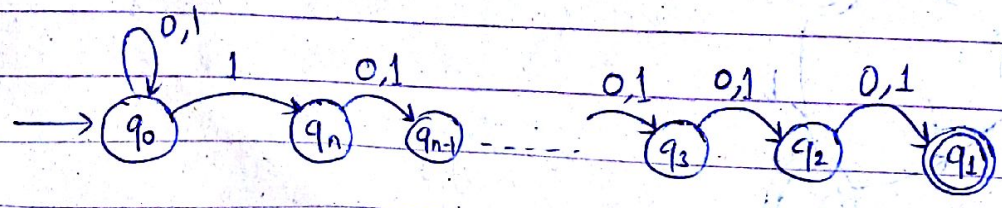

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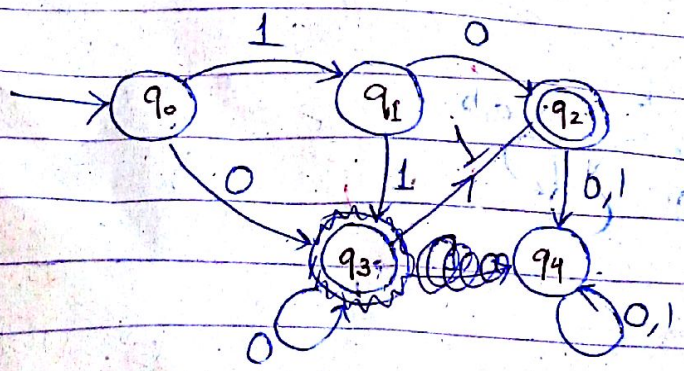


9. $S \to aAb \mid aSb$

$A \to bAa \mid ba$

(10) $A \to aAb \mid bAa \mid \in$

$A \to AA \mid \in$

11. $S \to aSb \mid AB$

$A \to bA \mid b$

(12) $S \to aSb \mid aA \mid bB$

$A \to aA \mid a$

$B \to bB \mid b$

Simplifying: $T_a \to a$, $T_b \to b$ Eliminating unit productions:

$S \to aSb \mid aAb \mid aBb \mid aA \mid a \mid bB \mid b$

$A \to aA \mid a$

$B \to bB \mid b$

Normalizing:

$T_a \to a$

$T_b \to b$

$A \to T_aA \mid a$

$B \to T_bB \mid b$

$K_1 \to ST_b$

$K_2 \to AT_b$

$K_3 \to BT_b$

$S \to T_aK_1 \mid T_aK_2 \mid T_aK_3 \mid T_aA \mid T_bB \mid a \mid b.$ (Ans.)

13. $S \rightarrow 011S \mid 1S \mid A$

$A \rightarrow 01A \mid \epsilon$

14. Assuming $m, n \geq 1$

$S \rightarrow AC \mid B$

$A \rightarrow aAb \mid \epsilon$

$C \rightarrow cC \mid \epsilon$

$B \rightarrow aB \mid D$

$D \rightarrow bDc \mid \epsilon$

15. $S \rightarrow aAbB$

$A \rightarrow aA \mid a$

$B \rightarrow bB \mid b$

Simplified already;

$T_a \rightarrow a$

$T_b \rightarrow b$

$A \rightarrow T_aA \mid a$

$B \rightarrow T_bB \mid b$

$K_1 \rightarrow T_bB$

$K_2 \rightarrow AK_1$

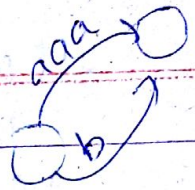
$S \rightarrow T_aK_2$

16.

NDFA (given)

16

State	a	b
→ q_0	q_1	q_0
q_1	q_0	q_2
q_2	q_3	q_1
* q_3	q_3	q_0
q_4	q_3	q_5
q_5	$q_4 q_6$	~~q_4~~ ϕ
q_6	q_5	-
q_7	q_6	q_3



Converting into DFA:

→ $[q_0]$	$[q_1]$	$[q_0]$
$[q_1]$	$[q_0]$	$[q_2]$
$[q_2]$	$[q_3]$	$[q_1]$
* $[q_3]$	$[q_3]$	$[q_0]$

No unused state found.

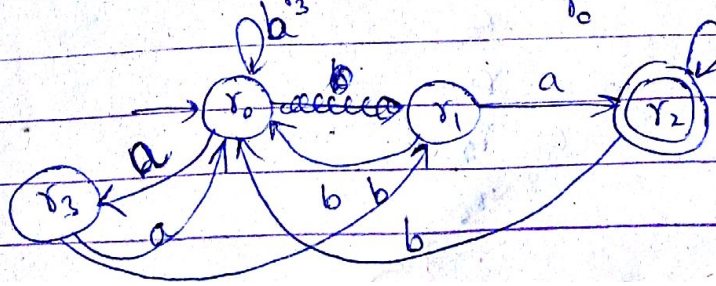
$\pi_0 = \{ q_0, q_1, q_2 \quad q_3 \}$

$\pi_1 = \{ q_0 q_1 \quad q_2 \quad q_3 \}$

$\pi_2 = \{ \underbrace{q_0 q_1}_{r_0\ r_3} \quad \underbrace{q_2}_{r_1} \quad \underbrace{q_3}_{r_2} \}$

:

State	a	b
→ r_0	r_3	r_0
r_1	r_2	r_0
* r_2 r_3	r_2 r_0	r_0 r_1



17.

	0	1
$\rightarrow *q_0$	q_1	q_3
q_1	q_4	q_2
$*q_2$	$q_1 q_5$	-
q_3	q_0	q_4
q_4	q_4	q_4
q_5	-	$q_2 q_4$

Converting into DFA

State	0	1
$\rightarrow *[q_0]$	$[q_1]$	$[q_3]$
$[q_1]$	$[q_4]$	$[q_2]$
$*[q_2]$	$[q_1 q_5]$	$[\phi]$
$[q_3]$	$[q_0]$	$[q_4]$
$[q_4]$	$[q_4]$	$[q_4]$
$[q_1 q_5]$	$[q_4]$	$[q_2 q_4]$
$*[q_2 q_4]$	$[q_1 q_4 q_5]$	$[q_4]$
$[q_1 q_4 q_5]$	$[q_4]$	$[q_2 q_4]$
$[\phi]$	$[\phi]$	$[\phi]$

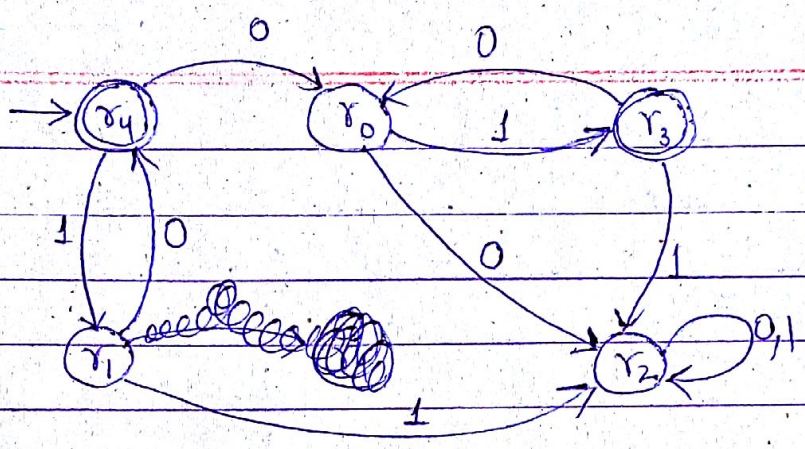
No useless state.

$\pi_0 = \{ q_1, q_3, q_4, q_{15}, q_{145}, \phi \quad q_0, q_2, q_{24} \}$

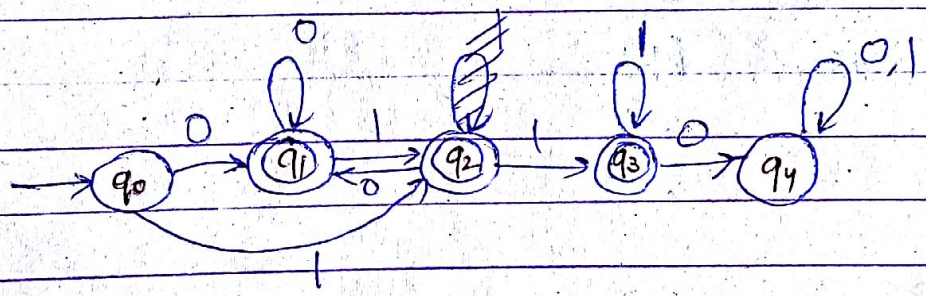
$\{ \underbrace{q_1, q_{15}, q_{145}}_{r_0}, \underbrace{q_3}_{r_1}, \underbrace{q_4, \phi}_{r_2}, \underbrace{q_0}_{r_4}, \underbrace{q_2 q_{24}}_{r_3} \}$

State	0	1
$\rightarrow *r_4$	r_0	r_1
$*r_3$	r_0	r_2
r_2	r_2	r_2
r_1	r_4	r_2
r_0	r_2	r_3

Minimized DFA:



(18)



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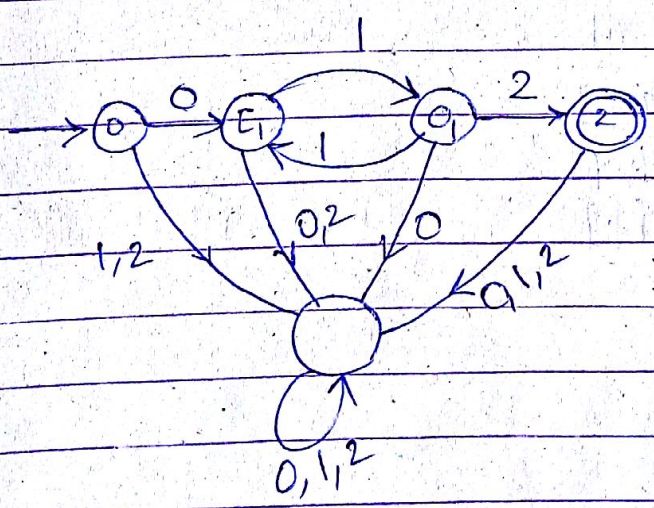


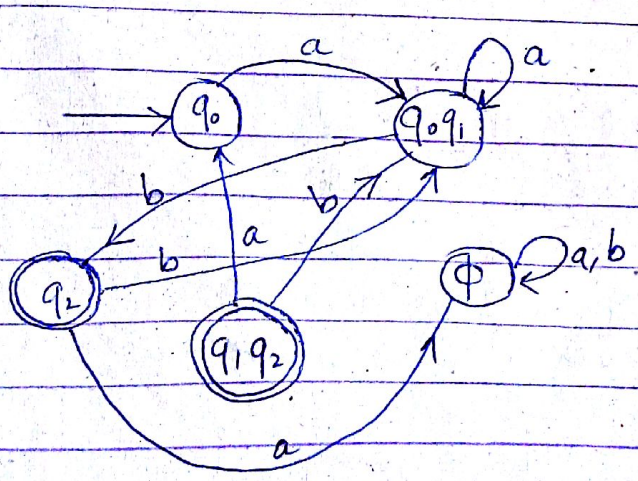
20.

21. NDFA

	a	b
→ q_0	$\{q_0, q_1\}$	$\{q_2\}$
q_1	q_0	q_1
* q_2	–	q_0, q_1

DFA :

→ $[q_0]$	$[q_0 q_1]$	$[q_2]$
* $[q_2]$	$[\phi]$	$[q_0 q_1]$
$[q_0 q_1]$	$[q_0 q_1]$	$[q_1 q_2]$
* $[q_1 q_2]$	$[q_0]$	$[q_0, q_1]$
$[\phi]$	$[\phi]$	$[\phi]$



22.

	0	1
→ q_0	q_1	q_3
q_1	q_2	q_4
q_2	q_1	q_4
q_3	q_2	q_4
* q_4	q_4	q_4

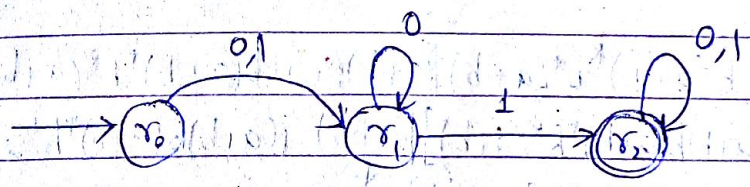
No unused state

$\pi_0 = \{ q_0\ q_1\ q_2\ q_3 \quad q_4 \}$

$\pi_1 = \{ q_0 , q_1 q_2 q_3 , q_4 \}$

$\pi_2 = \{ \underbrace{q_0}_{r_0} , \underbrace{q_1 q_2 q_3}_{r_1} , \underbrace{q_4}_{r_2} \}$

state	0	1
→ r_0	r_1	r_1
r_1	r_1	r_2
* r_2	r_2	r_2



23.

$q_1 = \epsilon$

$q_2 = q_1a + q_2b + q_3a + q_3b + q_4a + q_4b$

$q_3 = q_2a$

$q_4 = q_2b$

$q_3 = (q_1(a+b) + q_3(a+b) + q_4(a+b))a$

$= (a+b) + q_3(a+b) +$

$q_4 = (q_1(a+b) + q_3(a+b) + q_4(a+b))b$

$q_4 = (a+b)b + q_3(a+b)b + q_4(a+b)b$

$q_4 = ((\epsilon + q_3)(a+b)b)(a+b)^*b^*$

$q_3 = (a+b) + q_3(a+b) + ((\epsilon+q_3)(a+b)b)(a+b)^*b^*(a+b)$
$(\epsilon + b(a+b)^*b^*(a+b))$

$q_3 = (a+b) + q_3(a+b) + (a+b)b(a+b)^*b^*(a+b)$

$q_3 = (a+b)[\epsilon + b(a+b)^*b^*(a+b)] + q_3(a+b)(\epsilon + b(a+b)^*b^*(a+b))$

$q_3 = (a+b)[\epsilon + b(a+b)^*b^*(a+b)]^*(a+b)(\epsilon + b(a+b)^*b^*(a+b))^*$

$= [(a+b) + (a+b)b(a+b)^*b^*(a+b)][(a+b) + (a+b)b(a+b)^*b^*(a+b)]^*$

$= \{(a+b)[\epsilon + b(a+b)^*b^*(a+b)]\}^*$

$= \{(a+b)[+b(a+b)^*b^*(a+b)]\}^*$ (ANS)

$q_2 = (a+b) + q_2a(a+b) + q_2b(a+b)$

$q_2 = (a+b)[(a+b)(a+b)]^*$

$q_3 = a(a+b)[(a+b)(a+b)]^*$ (ANS)

24. $q_3 = q_2 a + q_4 a$

$q_2 = q_1(a+b) \Rightarrow q_2 = (a+b)$

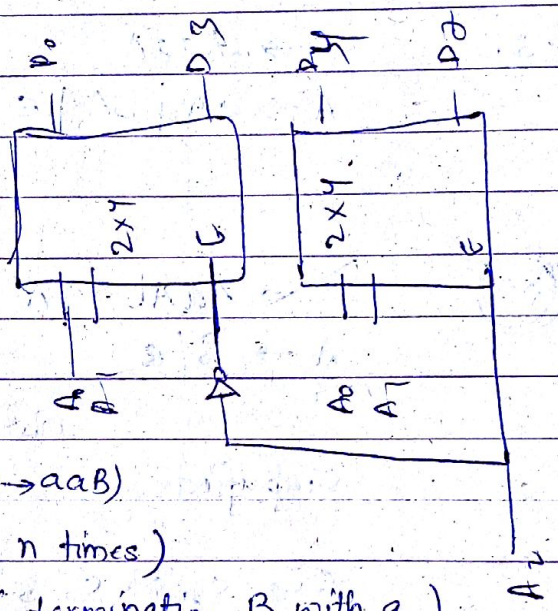
$q_1 = \epsilon$

$q_4 = q_3(a+b)$

$q_3 = (a+b)a + q_3(a+b)a$

$q_3 = (a+b)a[(a+b)a]^*$

$q_3 = ((a+b)a)^*$ (ANS.)



CHK NDFA

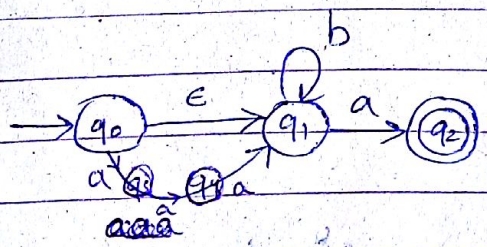
(25) $S \rightarrow a^*A \mid B$

$\rightarrow a(aaB) \mid B$ $(A \rightarrow aaB)$

$\Rightarrow aaab^nB \mid b^nB$ (n times)

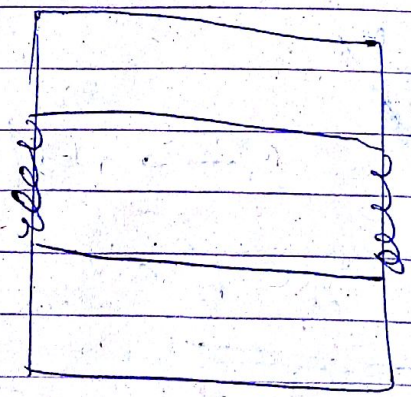
$\rightarrow aaab^na \mid b^na$, $n \geq 0$ (terminating B with a)

R.E. $\Rightarrow$ $a^3b^*a + b^*a$



26. $S \rightarrow AaaA$

$A \rightarrow aA \mid bA \mid \epsilon$



27. $S \rightarrow aSa \mid bSb \mid b \mid a$

28. $S \rightarrow aSc \mid A$

$A \rightarrow aAb \mid \epsilon$

29. Assuming 'OR' is 'AND':

$S \to aAB \mid bDB$

$A \to aAb \mid \epsilon$

$C \to cCc \mid \epsilon$

$D \to aD \mid \epsilon$

$B \to bBc \mid E$

$E \to cE \mid \epsilon$

$B \to bBc \mid DBE \mid \epsilon$

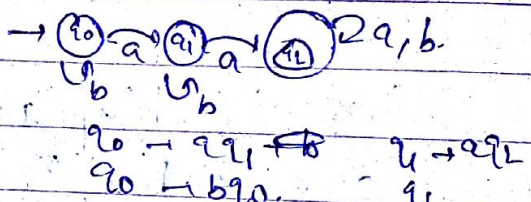
$D \to aD \mid BC$

$E \to Ec \mid \epsilon$

30. $S \to AaaA$

$A \to aA \mid bA \mid \epsilon$

$S \to AaAaA$



$q_0 \to aq_1$ $q_1 \to aq_2$

$q_0 \to bq_0$ q_1

31. $S \to AaAbAaA \mid AaAaAbA \mid AbAaAaA$

$A \to S \mid \epsilon$

OR

Simplified:

$S \to SaSbSaS \mid SaSaSbS \mid SbSaSaS \mid \epsilon$

$S \to aSbSa \mid aSaSb \mid bSaSa \mid SS \mid \epsilon$

aa^nbaa

$S \to aba \mid aaSaa$

$a^n b^n c^n$