

TOA ASSIGNMENT 03A

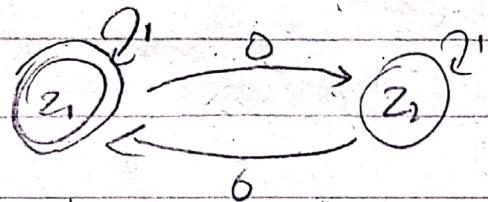
Bilal Ahmed Khan

K20-0183

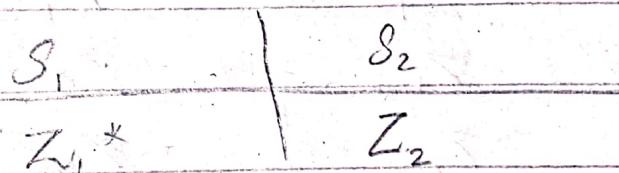
Section: B

QUESTION 01 (DFA Minimization)

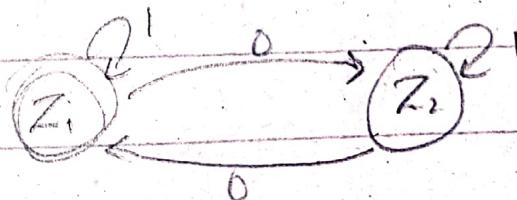
i)



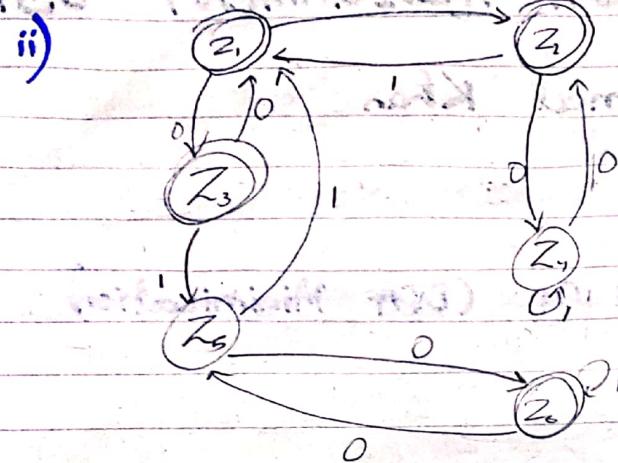
	0	1	
Z1	Z2	Z1	
Z2	Z1	Z2	



Minimized DFA:



ii) DFA Minimization



Transition Table:

States	0	1
Z ₁ *	Z ₃	Z ₂
Z ₂ *	Z ₄	Z ₁
Z ₃ *	Z ₁	Z ₅
Z ₄	Z ₂	Z ₆
Z ₅	Z ₆	Z ₁
Z ₆ *	Z ₅	Z ₆

S₁, S₂ | S₃, S₄

Z₁, Z₂, Z₃, Z₆ | Z₄, Z₅

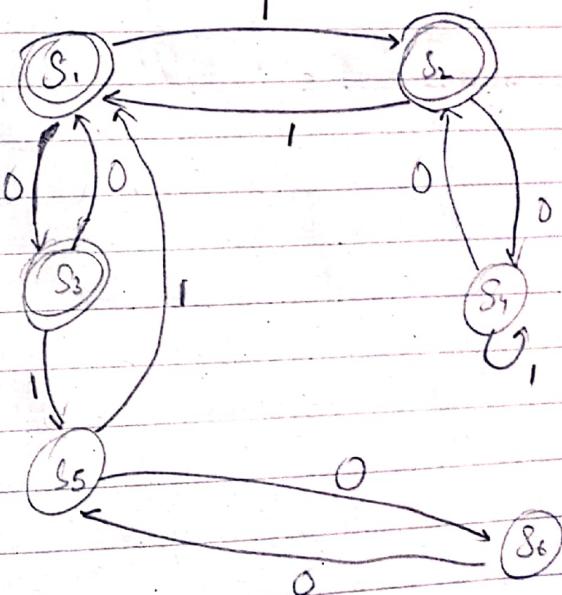
S₁ | S₂ | S₃, S₄

Z₁, Z₅ | Z₂, Z₆ | Z₃, Z₄

S₁ | S₂ | S₃ | S₄ | S₅ | S₆

Z₁ | Z₅ | Z₂ | Z₃ | Z₆ | Z₄

Minimized DFA:



QUESTION 02: RG E PDA

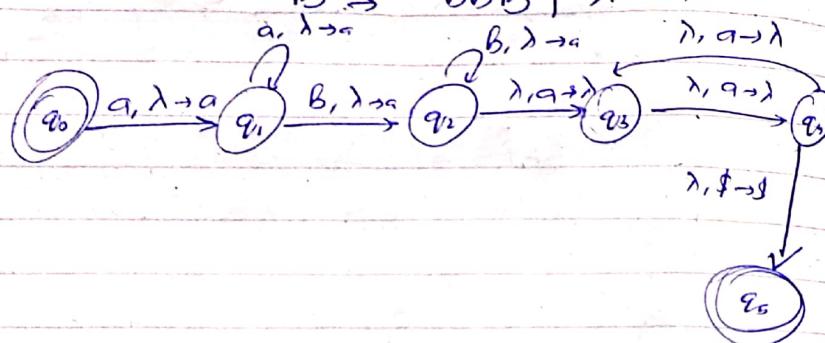
a) $\{a^n b^n : (n+m) \text{ is even}\}$

RG

$$A \rightarrow aABb | AB$$

$$A \rightarrow aaA \mid \lambda$$

$$B \rightarrow BBB |\lambda$$

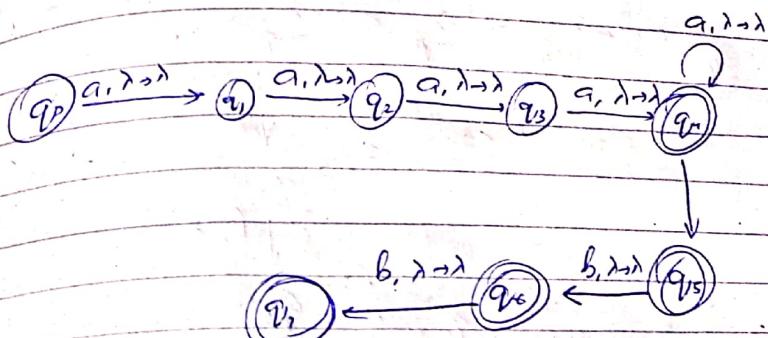


$$B \quad \{a^n b^m : n \geq 4, m \leq 3\}$$

$$S \rightarrow AB$$

A → aaaa laf

$$B \rightarrow \lambda b \bar{b} b \bar{b}$$

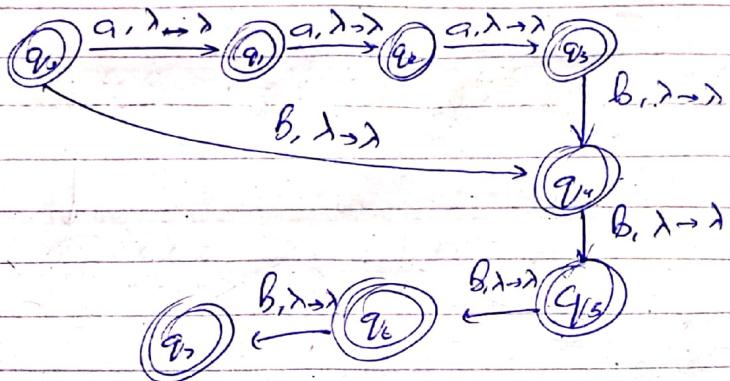


c) $\{a^nb^m, n < 4, m \leq 4\}$

$$S \rightarrow AB$$

$$A \rightarrow \lambda | a | aa | aaa$$

$$B \rightarrow \lambda | b | BB | BBB | BBBB$$

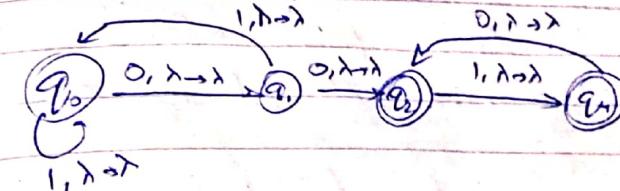


d) having exactly one pair of consecutive zeros

$$S \rightarrow ABD\lambda | \lambda$$

$$A \rightarrow 0 | A | 1 | A | \lambda$$

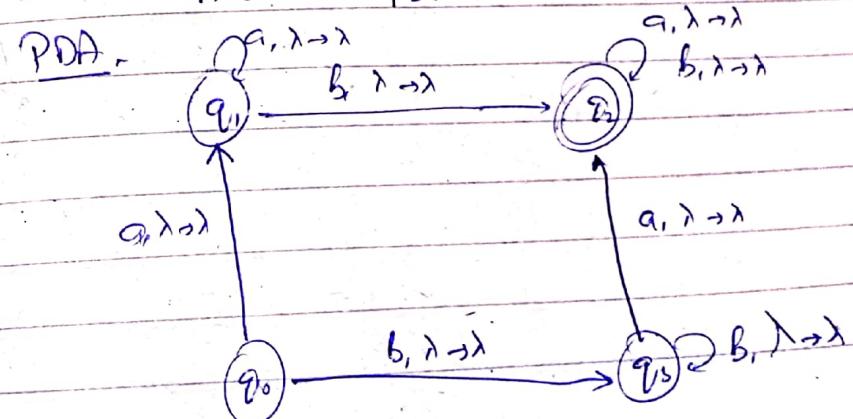
$$B \rightarrow 1 | 0 | B | 1 | B | \lambda$$



e) all strings that contain atleast one occurrence of each symbol in alphabet

RGr $S \rightarrow AaABA | ABAaa$

$$A \rightarrow aA | bA | \lambda$$



f) all strings not ending in 0,1

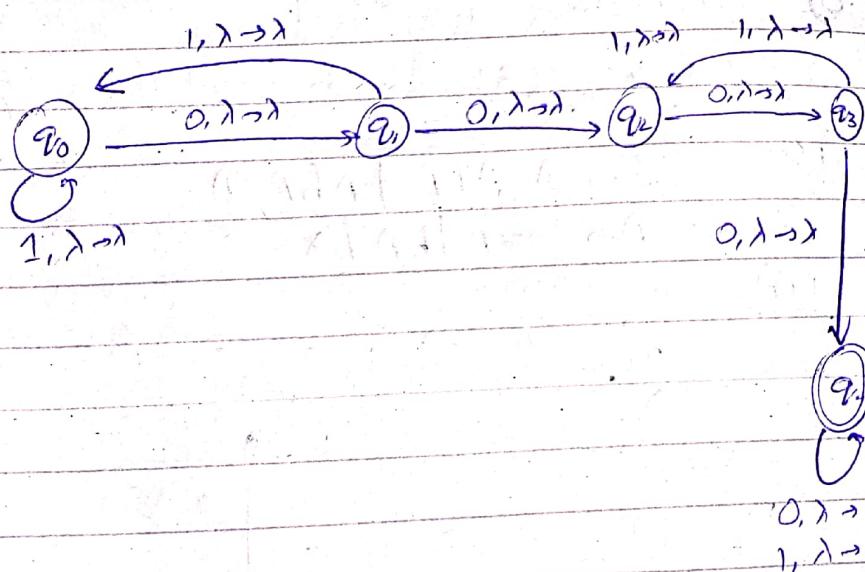
$$S \rightarrow \lambda$$



g) all strings having at least two occurrences of substring 00.

$$S \rightarrow A \text{ } 0 \text{ } 0 \text{ } A \text{ } 0 \text{ } 0 \text{ } A$$

$$A \rightarrow 0A \mid 1A \mid A$$



h) $\{ w : n_a(w) \equiv (\omega) \bmod 3 = 0 \}$

$$S \rightarrow A \text{ } a \mid S \mid \lambda$$

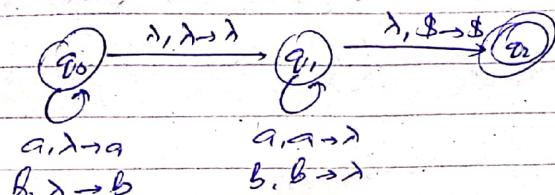
$$A \rightarrow bA \mid b$$



QUESTION 03 (Part 01)

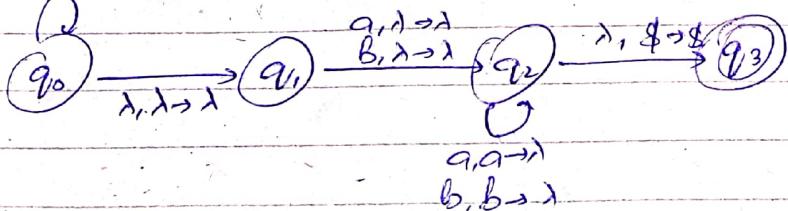
a) Even length Palindrome:

$$S \rightarrow aSa | BSB | aa | bb | \lambda$$

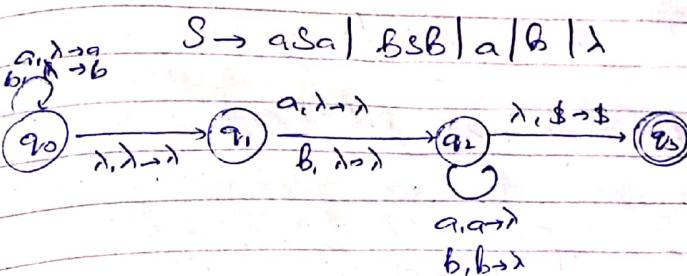


b) Odd length Palindromes:

$$S \rightarrow aSa | BSB | a | b$$

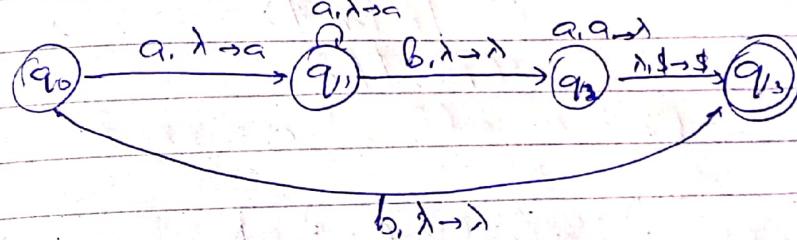


c) The language of all Palindromes:



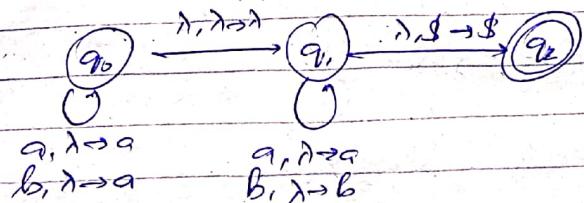
d) $a^n b a^n$

$$S \rightarrow aSa | B$$



e) $\text{ww: w} \in \{a, b\}^*$

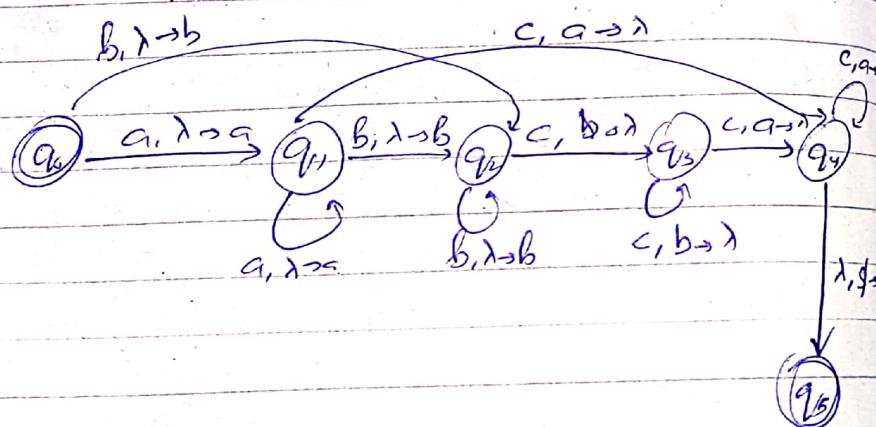
$S \rightarrow aS / bS / \lambda$



f) $ab^m c^{n+m}$

$S \rightarrow aSc / A / ac / \lambda$

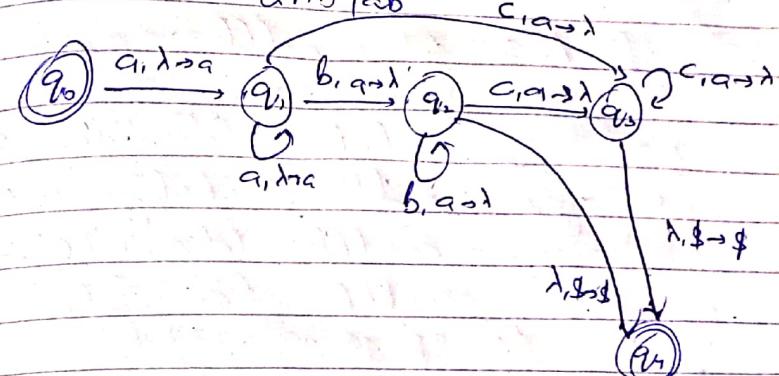
$A \rightarrow bAc / bc$



g) $\{a^{n+m} b^m c^n\}$

$S \rightarrow aSc / A / ac / \lambda$

$A \rightarrow aAb / ab$



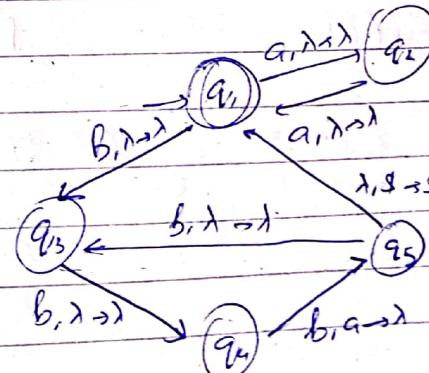
h) $\{a^n b^{n+m} c^n\}$

$S \rightarrow Ab / \lambda$

$A \rightarrow aAb / ab$

$B \rightarrow bBc / Bc$

$S \rightarrow aa\$bb\cc/λ



Q63 (Part 02)

i) $L = \{a^{2n}b^{3n}\}$

If $N=3$ let $w=aabbba \rightarrow x=a, y=b, z=bbb$

i=0: $xy^iz = abbb$ (doesn't belong to L)

i=1: $xy^iz = aabbba$ (belongs to L)

i=2: $xy^iz = aaabbbb$ (doesn't belong to L)

i=3: $xy^iz = aaaaabbb$ (doesn't belong to L)

Language is not regular.

ii) $L = \{a^n b^{n+m} c^m\}$

let $w = abbc \rightarrow x=a; y=b; z=c$

i=0: $xy^iz = abc$ (doesn't belong to L)

i=1: $xy^iz = abbc$ (belongs to L)

i=2: $xy^iz = abbbc$ (doesn't belong to L)

i=3: $xy^iz = abbbbc$ (doesn't belong to L)

Therefore we can say that the language is not regular.

iii). $L = \{a^n b a^n\}$

let $w = aabbba \rightarrow x=a, y=b, z=ba$

i=0: $xy^iz = abba$ → does not belong to L

i=1: $xy^iz = aabba$ → belongs to L

i=2: $xy^iz = aaabba$ → doesn't belong to L

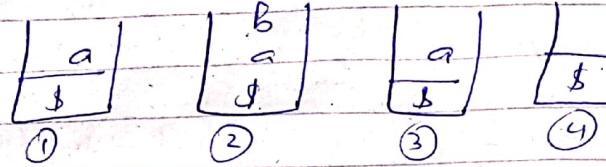
i=3: $xy^iz = aaaaabba$ → doesn't belong to L

Thus we can say that it's not a regular language.

Q3 Part 03 (Stack Operations)

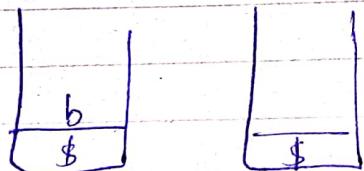
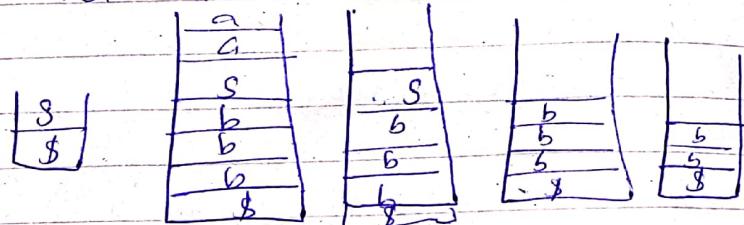
a) $a^n b a^n$

let $n=1$ so aba



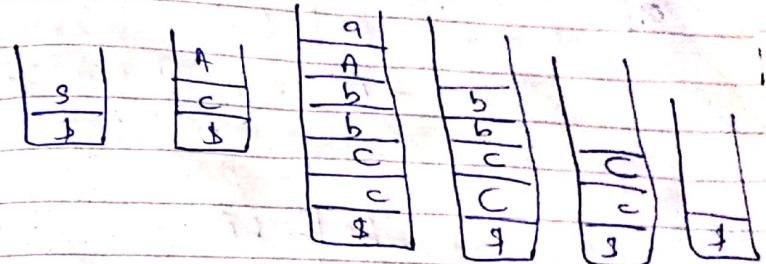
b) $a^{2n} b^{3n}$

let $n=1 \Rightarrow aa bbb$



c) $L = \{a^nb^{n-m}c^m\}$

let $n=m=1 \Rightarrow abbc$



QUESTION 04

01) $S \rightarrow abS | aBA | abB^*$
 $A \rightarrow cd$

$B \rightarrow aB$ \rightarrow (B is not generative)
 $C \rightarrow dc$ \rightarrow (C is not reachable)

$S \rightarrow abS | aBA$
 $A \rightarrow cd$

$S \rightarrow abS | abc$

02) $S \rightarrow ABC | a$
 $A \rightarrow b$

$B \rightarrow c$

$C \rightarrow d$

$E \rightarrow e$ \times

$F \rightarrow f$ \times

$G \rightarrow g$ \times

$S \rightarrow ABC | a$

$A \rightarrow B$

$B \rightarrow c$

$C \rightarrow d$

Putting $A \rightarrow b$, $B \rightarrow c$, $C \rightarrow d$

$S \rightarrow bcd | a$

03) $S \rightarrow aB | bx$

$A \rightarrow Bad | BSx | a$ \times

$B \rightarrow aSB | BBx$

$X \rightarrow aBD | aBx | ad$

$A \in D$ are not reachable

$S \rightarrow a\overset{x}{B} | bx$

$B \rightarrow aSB | BBx$ \times

$X \rightarrow a\overset{x}{B}x | ad$

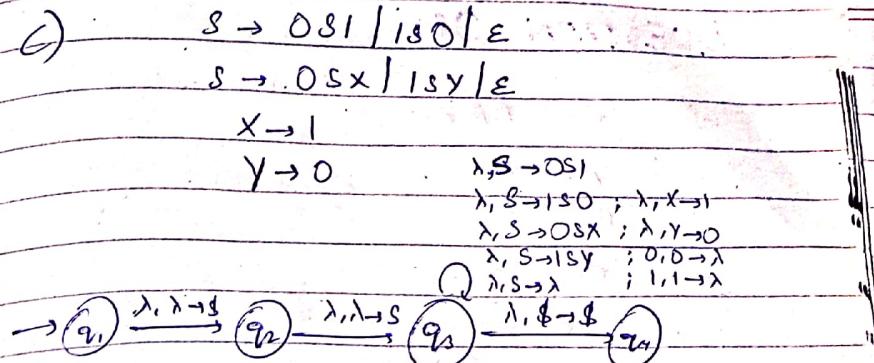
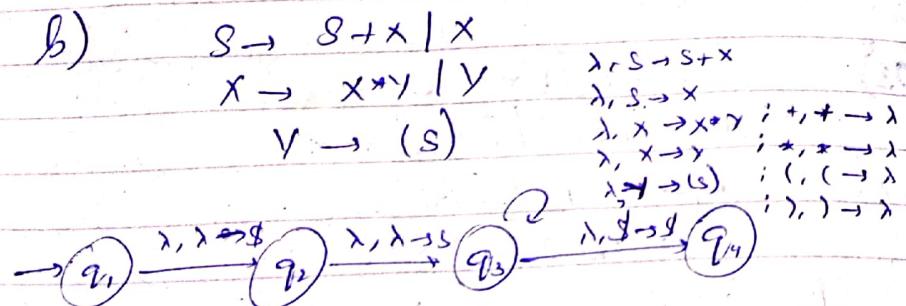
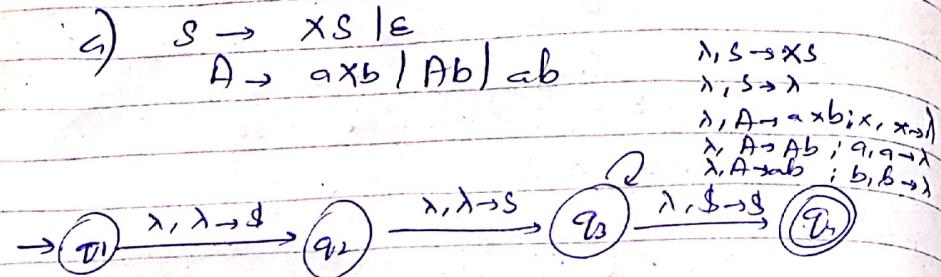
B is not generative

$S \rightarrow BX$

$X \rightarrow ad$

$\boxed{S \rightarrow bad}$

QUESTION 05 CFG to PDA



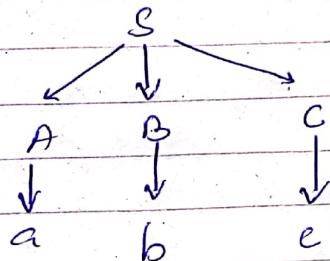
QUESTION 06:

01) $S \rightarrow ABC$

$$A \rightarrow a$$

$$B \rightarrow b$$

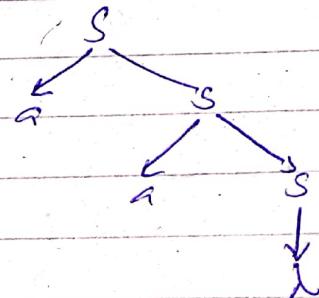
$$C \rightarrow c$$



If its unambiguous.



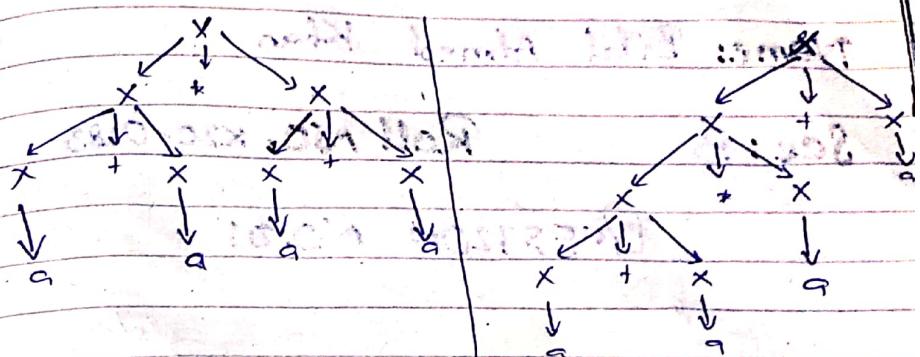
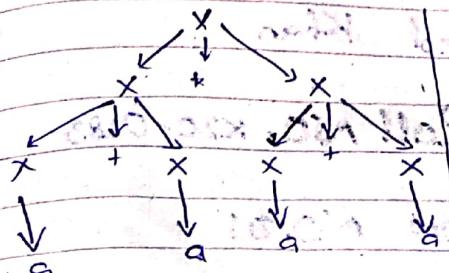
02) $S \rightarrow aS | \lambda$



If its unambiguous.

03)

$$S \rightarrow x \rightarrow x + x \cdot 1 \cdot x + x \cdot (x) \cdot a$$



Its ambiguous.

END OF ASSIGNMENT