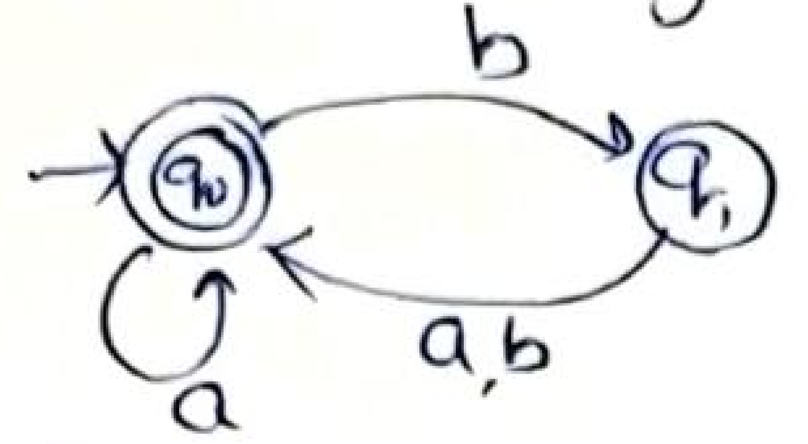
Autumn End Sem. Exam. 2019.
FAA - CS3003

Q.1

a) A grammar G is said to be right-linear iff all productions are of the form $A \rightarrow xB$, $A \rightarrow x$ where $A, B \in V$ and $x \in T^*$.

(NO). ~~The~~ $A \rightarrow Bx | x$ is a regular grammar which is not right-linear.

b)



c) y will be $a^k b^k$

Hence y^3 will be $a^k b^k a^k b^k a^k b^k$ or $(a^k b^k)^3$.

d) A lang L is said to be recursively enumerable iff.

(i) If $w \in L$, then Turing Machine halts in a final state

(ii) if $w \notin L$, then

- Turing machine halts in a non-final state
- Turing machine falls in an infinite loop. (or)

e) $S \rightarrow Saa | Sb | B$

$B \rightarrow Ba | a$

f) Def^n. from book (refer)

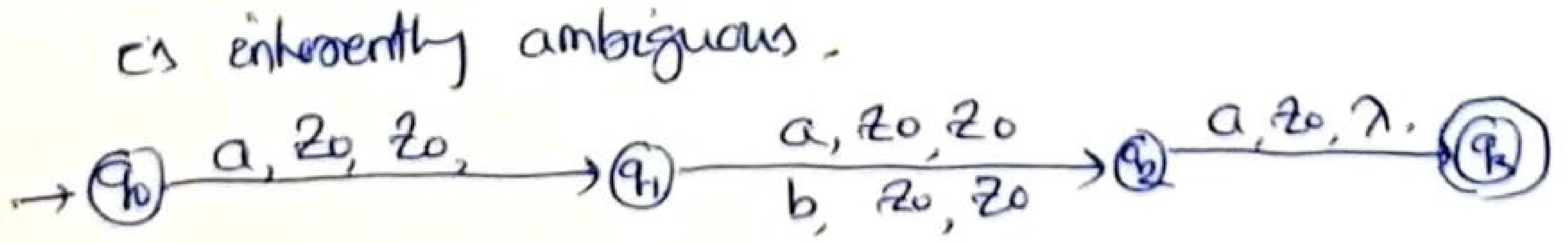
g) Regular language, context-free lang, and Recursively enumerable.

h) A Language is said to be inherently ambiguous iff every grammar that generates it is ambiguous.

e.g. $L = \{a^n b^m c^n \mid n, m \geq 1\} \cup \{a^n b^m c^m \mid n, m \geq 1\}$

is inherently ambiguous.

i)



j) The movement is possible if

$\delta(p, a_4) = (q, a_3, L)$

Q2.

a) Removal of λ-production

$S \to aAa \mid aa \mid bBb \mid bb$
$A \to a$
$B \to b$
$C \to CE \mid DE \mid E$
$D \to ab$

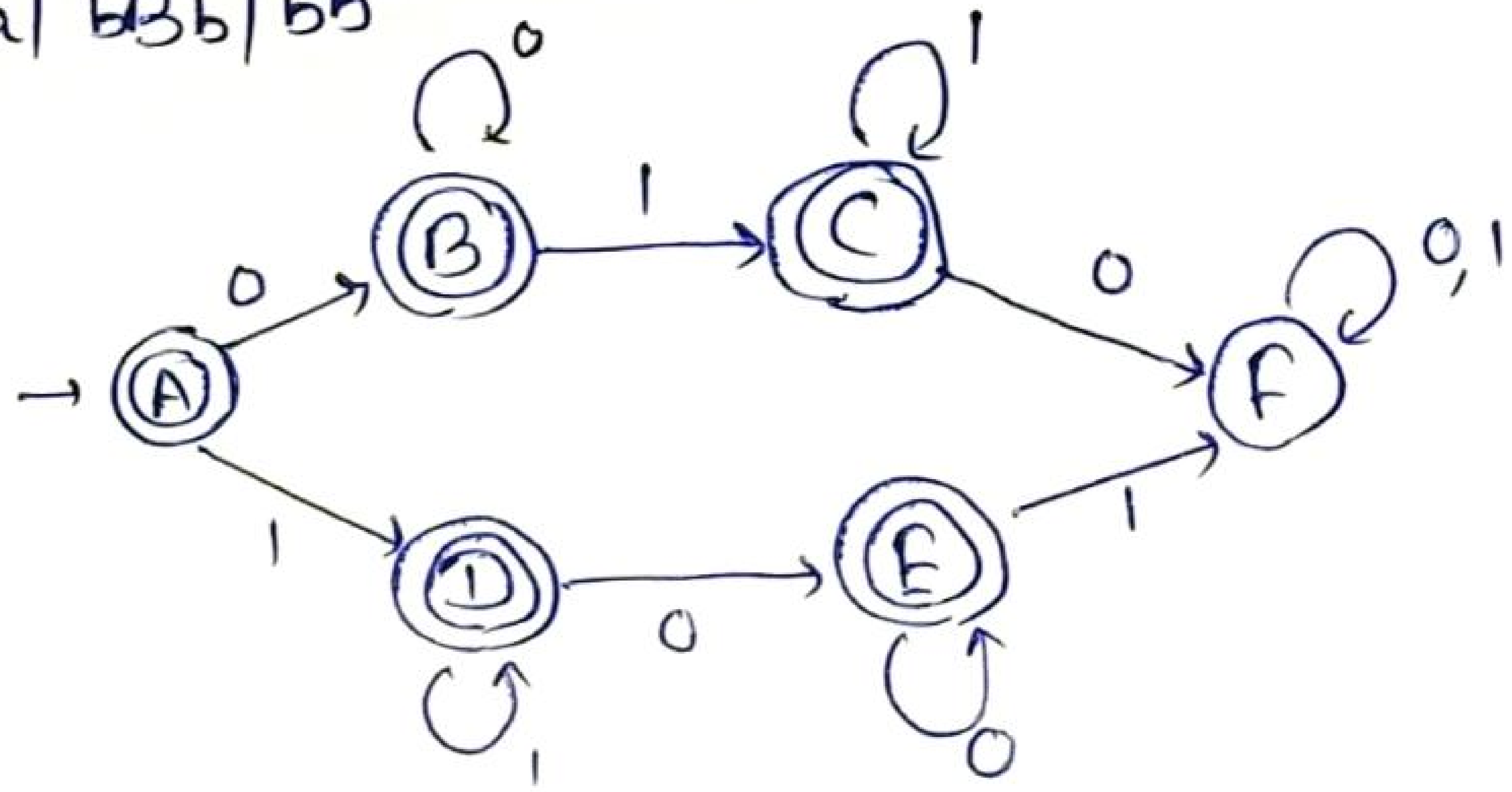
Removal of Unit production

$S \to aAa \mid aa \mid bBb \mid bb$
$A \to a$
$B \to b$
$C \to CE \mid DE$
$D \to ab$

After removal of useless-production.

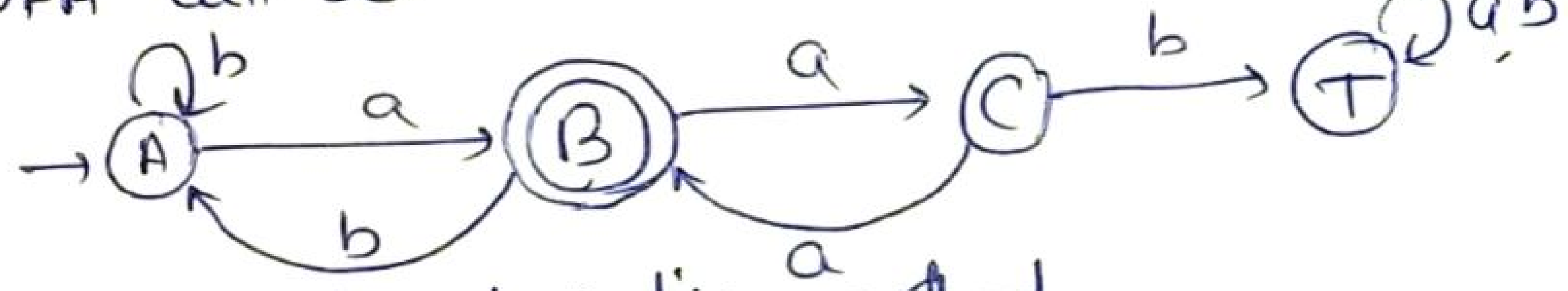
$S \to aAa \mid aa \mid bBb \mid bb$
$A \to a$
$B \to b.$

b)

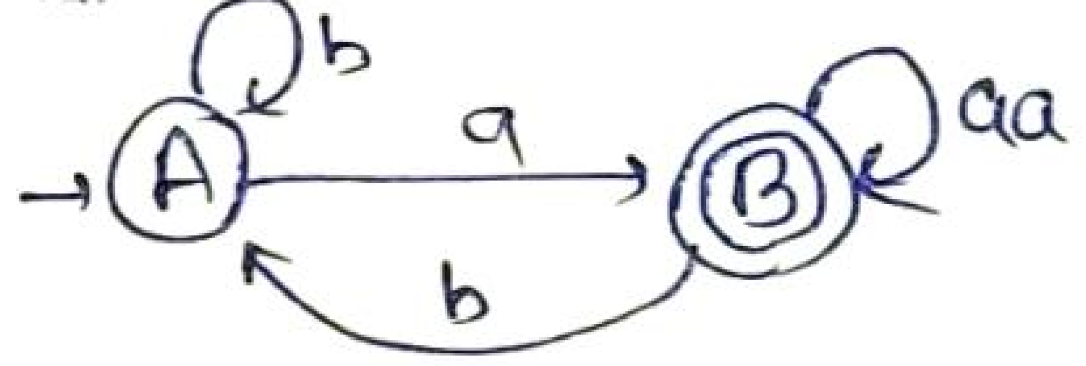


Q-3

a) DFA will be.



Applying state elimination method.



$r = b^*a\,(aa + bb^*a)^*$

b) Let w be $a^m b^m$ and positive constant be m.

Then, the string of L will be $a^m b^m a^m b^m$

Divide the string, let.

$x = a^{m-k},\ y = a^k,\ z = b^m a^m b^m.$

where $1 \le k < m$

Then $xy^2z = a^{m-k} a^{2k} b^m a^m b^m$

$= a^{m+k} b^m a^m b^m \notin L$

Hence L is not regular.

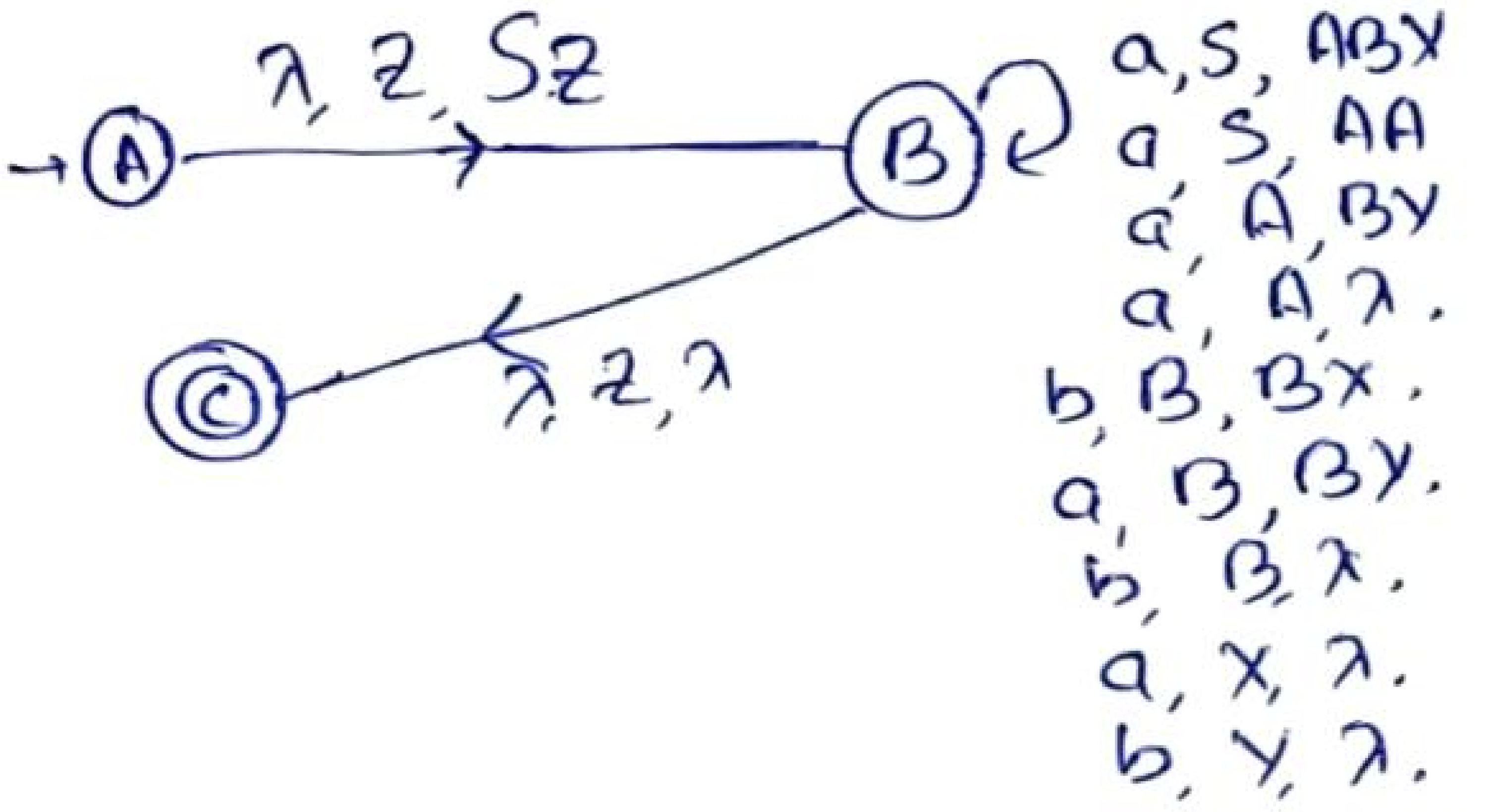
Q4.

a) (i) $S \to 0 \mid 0S0 \mid 1S1 \mid 0S1 \mid 1S0$

(ii) $S \to AB$
$A \to aAb \mid ab$
$B \to bBc \mid \lambda$.

b)

$S \to aABa \mid aAA$	$S \to aABa \mid aAA$	$S \to aABX \mid aAA$
$A \to aBb \mid b$	$A \to aBb \mid b$	$A \to aBY \mid b$
$B \to bBa \mid A$	$B \to bBa \mid aBb \mid b$	$B \to bBX \mid aBY \mid b$
		$X \to a$
		$Y \to b$



Q.5

a) Let L is a finite context free lang. Then there exist some positive integer m, such that any $\omega \in L$, with $|\omega| \geq m$, can be decomposed as $\omega = uvxyz$ with,

$|vxy| \leq m$
$|vy| \geq 1$
$uv^i x y^i z \in L$ for all $i = 0, 1, 2 \ldots$

Proof :-
Let $L_1 = \{a^n b^n c^m \mid n \geq 0, m \geq 0\}$
$L_2 = \{a^n b^m c^m \mid n \geq 0, m \geq 0\}$.

$L_\phi = L_1 \cap L_2$
$= \{a^n b^n c^n \mid n \geq 0\}$
= which is not a context free lang.

$L_1 \cap L_2 = \overline{\overline{L_1} \cup \overline{L_2}}$

L.H.S ⇒ not context free. ⇒ right side can not be context free.

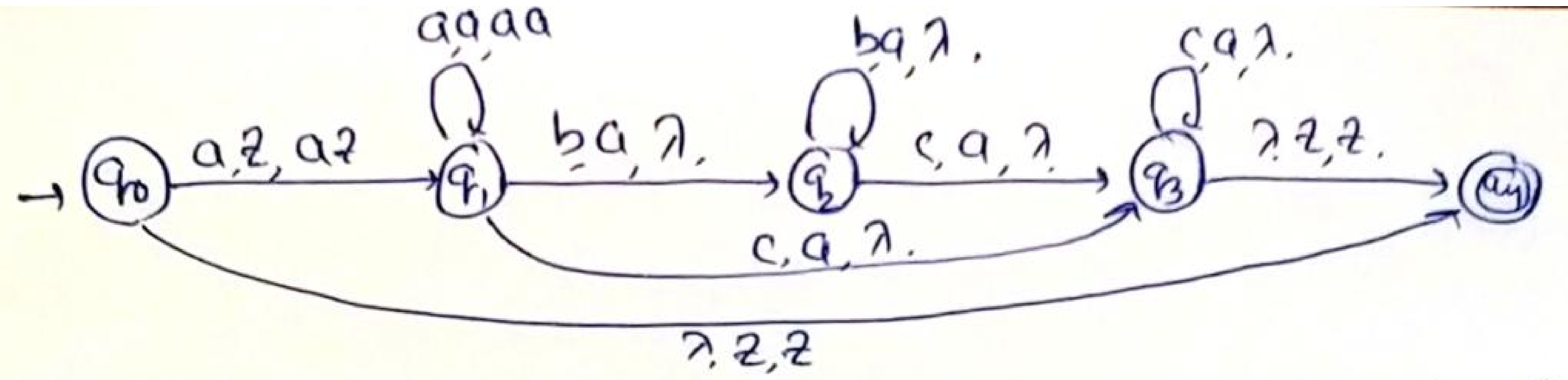
⇒ But we know that (According to Th^m) $L_1 \cup L_2$ is context free if L_1 & L_2 are context free.

⇒ complement can not be context-free.
proved.

b)

Q-6

a)



b) $(q_0, aabc, z) \vdash (q_1, abc, az) \vdash (q_1, bc, aaz) \vdash (q_2, c, az) \vdash (q_3, \lambda, z)$
$\vdash (q_4, z)$
Accept.

Q.7

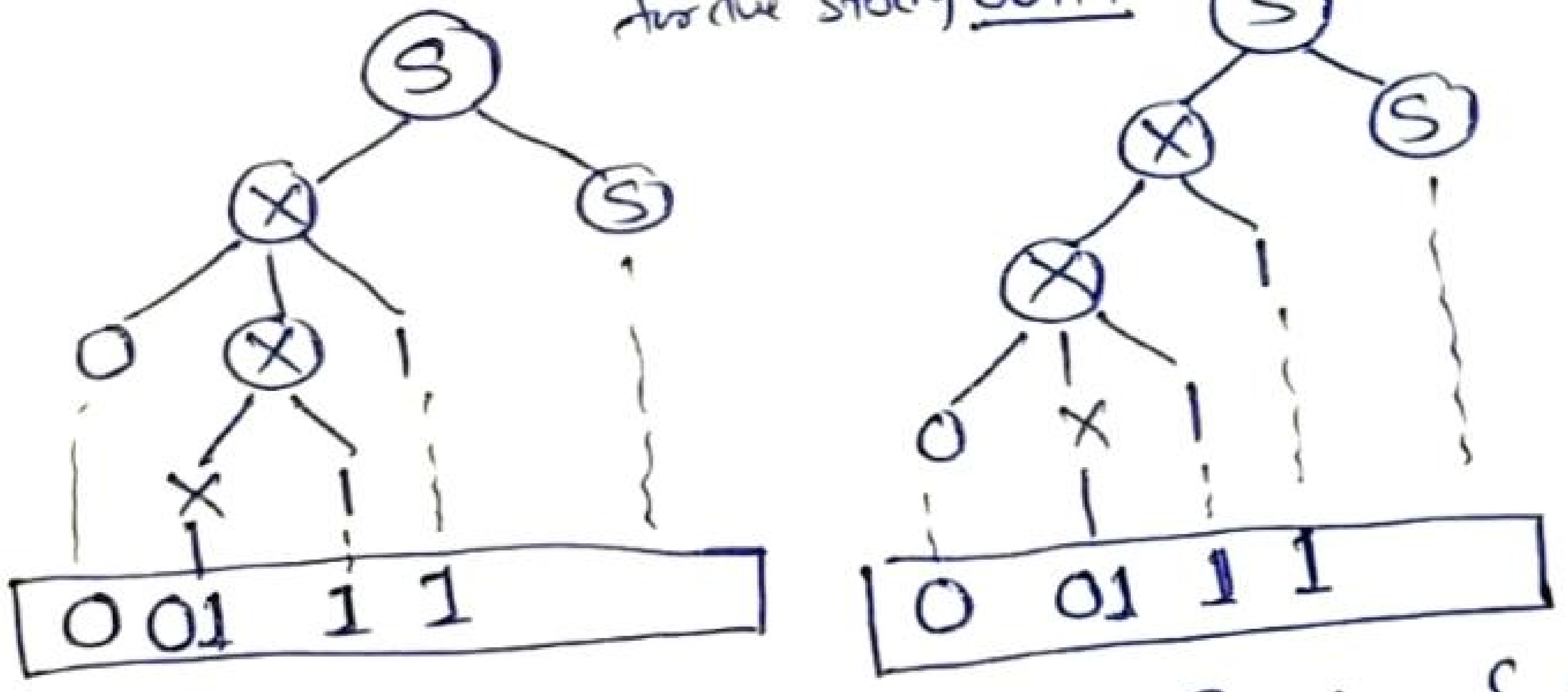
a) Possibility 1: by considering second last symbol either 0 or 1.
if the answer is correct provide marks.

possibility 2: (i) if someone consider 2 is not an input symbol
then, $L = \phi$.
then design non-deterministic finite acceptor for L.
(ii) Again need to specify L^R which is here again L
so. design non-deterministic finite acceptor for EI.
(which is same DFA).

~~b)~~ $\boxed{N.B}$ if some one written ~~not~~ design not possible/
question is wrong, then award 0 (zero) marks to that.

b)

for the string 0011



it is ambiguous.

Q.8

(a) (i) $L = \{ a^k (bb)^m a^k \mid k \geq 0, m \geq 1 \}$

(ii) $S \to aSa \mid B$
$B \to bb \mid bBb$

$S \to aSa \mid bb \mid bBb$, $B \to$ ~~bb~~ $\mid bBb$

$S \to XSX \mid YY \mid YBY$
$B \to YY \mid YBY$
$X \to a$
$Y \to b$

$\hat{G}$!
$S \to MX \mid YY \mid NY$
$M \to XS$
$N \to YB$
$B \to YY \mid NY$
$X \to a$, $Y \to b$

(b) $L = \{ a^n b^n cc \mid n \geq 1 \}$.