1 Q.P Code 00023707

Q.1

a) Chomsky Hierarchy
- Type
- Languages
- Form of productions in grammar
- Accepting device.

b) Differentiate between DFA and NFA.
- Define DFA, NFA
- STF

c) Explain Recursive and Recursively enumerable Language.

d) Define RE. Strings accepting 2 consecutive 1's

$$(0+1)^* 11 (0+1)^*$$

Q.2

a) Ternary number divisible by 5

Q \ Σ	0	1	2
q_s	q_0	q_1	q_2
q_0	q_0	q_1	q_2
q_1	q_3	q_4	q_0
q_2	q_1	q_2	q_3
q_3	q_4	q_0	q_1
q_4	q_2	q_3	q_4

Q. 2

b) Define pumping lemma for RL

$$L = \{a^n b^n \mid n >= 1\}$$

$$L = \{a^1b^1, a^2b^2, a^3b^3, \dots\}$$

Let us assume L is regular language.

Let $n = 4$ and z is a word in L

s.t. $|z| \geq n$.

$$z = a^3b^3 = aaabbb$$

we can rewrite z as uvw where

$|uv| \leq n$ and $|v| \geq 1$

$u = a$ $v = aa$ $w = bbb$ $|uv| = 3 \leq 4$

$|v| = 2 \geq 1$

$\forall\, uv^iw$ $i = 0, 1, 2, 3, \dots$

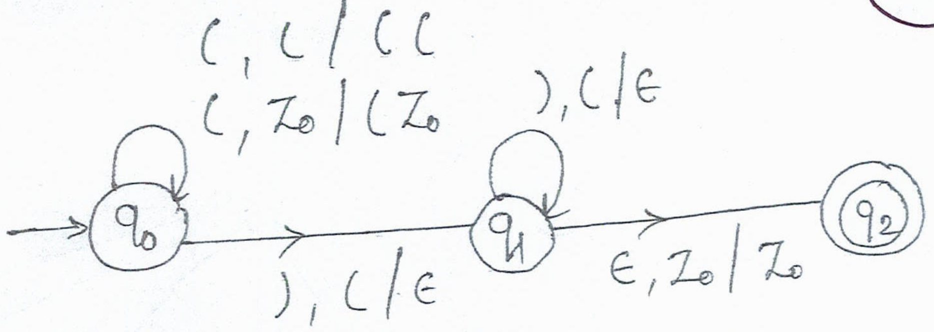
let $i = 0$

$$uv^iw = a(aa)^0 bbb$$
$$= abbb$$
$$= a^1b^3 \notin L$$

we get contradiction. Hence L is not regular.

Q.3

a)



$\delta(q_0, (, Z_0) = (q_0, (Z_0)$

$\delta(q_0, (, () = (q_0, (()$

$\delta(q_0,), () = (q_1, \epsilon)$

$\delta(q_1,), () = (q_1, \epsilon)$

$\delta(q_1, \epsilon, Z_0) = (q_2, Z_0)$

b) CFG $S \rightarrow iCtS \mid iCtSeS \mid a$

$C \rightarrow b$

For the string "ibtibtaea"

LMD

$S \Rightarrow iCtS$

$\Rightarrow ibtS$ $\quad C \Rightarrow b$

$\Rightarrow ibtiCtSeS$ $\quad S \Rightarrow iCtSeS$

$\Rightarrow ibtibtSeS$ $\quad C \Rightarrow b$

$\Rightarrow ibtibtaeS$ $\quad S \Rightarrow a$

$\Rightarrow ibtibtaea$ $\quad S \Rightarrow a$

RMD

$S \Rightarrow iCtS$

$\Rightarrow iCtiCtSeS$ $\quad S \Rightarrow iCtSeS$

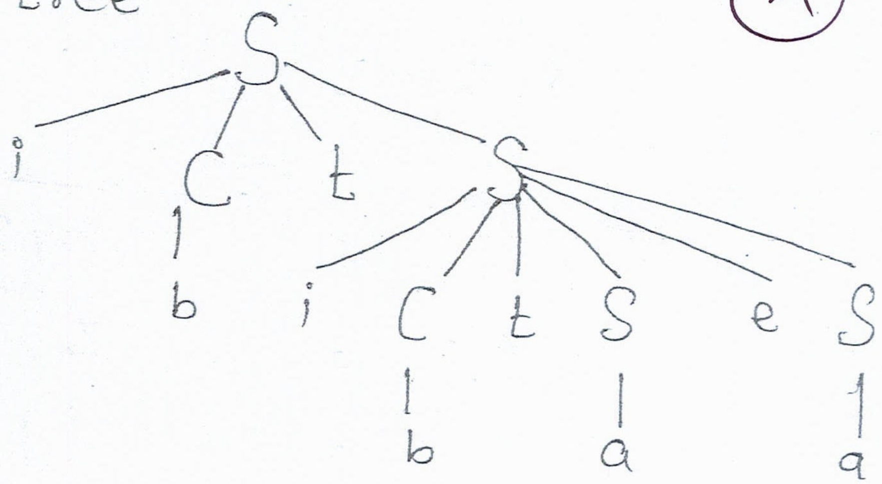
$\Rightarrow iCtiCtSea$ $\quad S \Rightarrow a$

$\Rightarrow iCtiCtaea$ $\quad S \Rightarrow a$

$\Rightarrow iCtibtaea$ $\quad C \Rightarrow b$

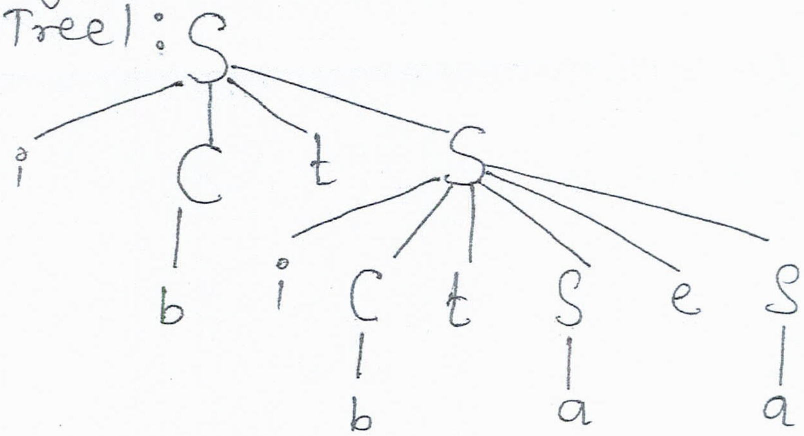
$\Rightarrow ibtibtaea$ $\quad C \Rightarrow b$

Parse tree

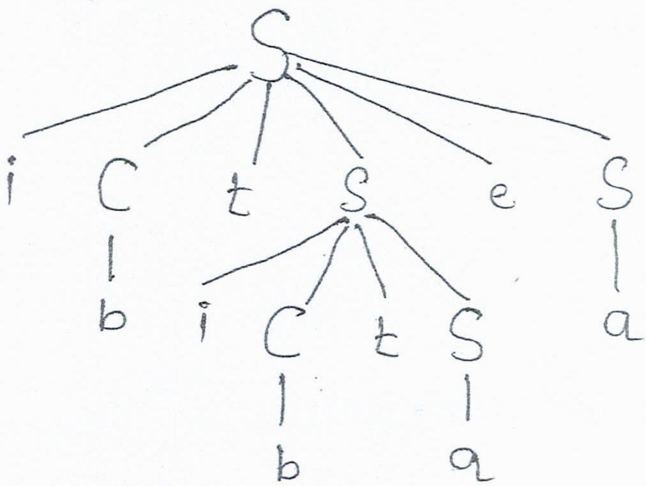


Ambiguous

ParseTree1:



Parse Tree 2:

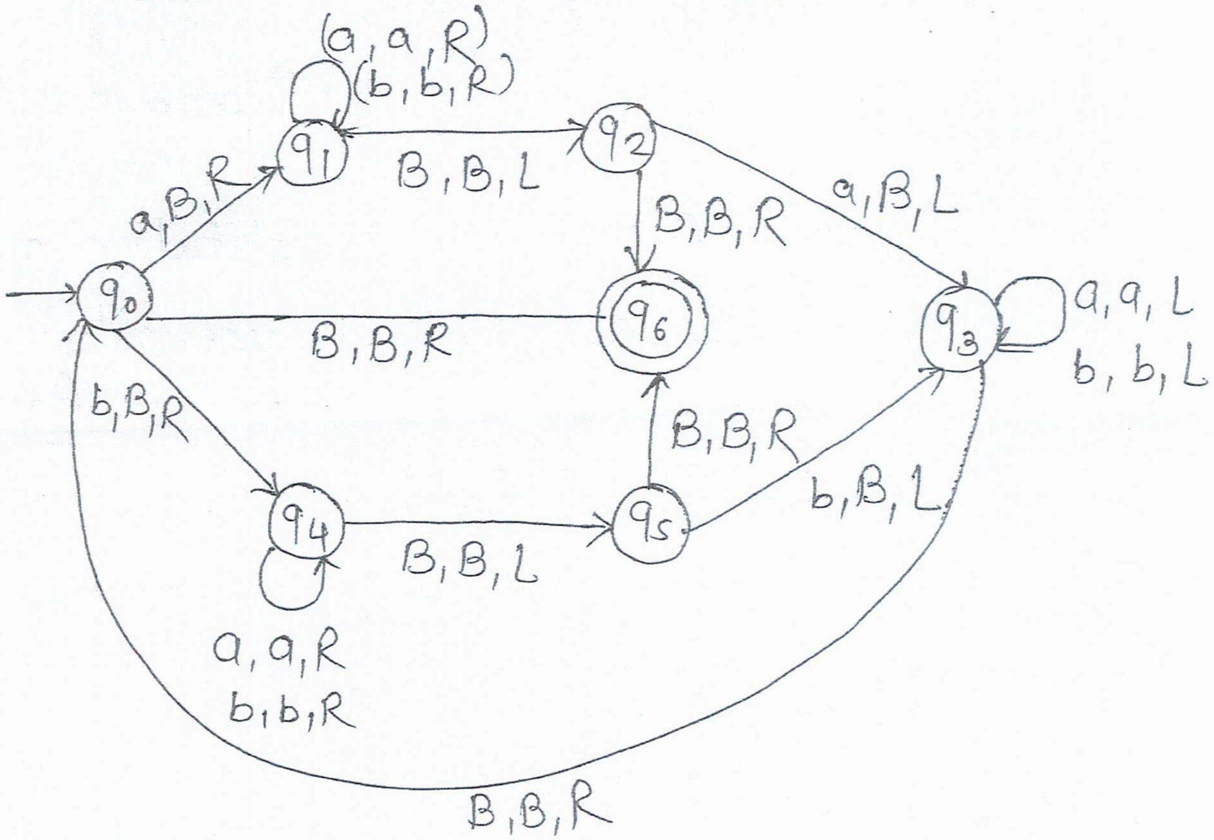


Two parse tree exists for the same string

Hence given grammar is ambiguous.

Q.4

a) Turing machine that recognizes palindrom over $\Sigma = \{a, b\}$



b) GNF

$S \rightarrow AB$

$A \rightarrow BSB \mid BB \mid b$

$B \rightarrow a$

Relable the variables

S with A_1

~~X with A_2~~

A with A_2

B with A_3

$S \rightarrow AB$ becomes $A_1 \rightarrow A_2 A_3$

$A \rightarrow BSB \mid BB \mid b$ $\quad A_2 \rightarrow A_3 A_1 A_3 \mid A_3 A_3 \mid b$

$B \rightarrow a$ $\quad A_3 \rightarrow a$

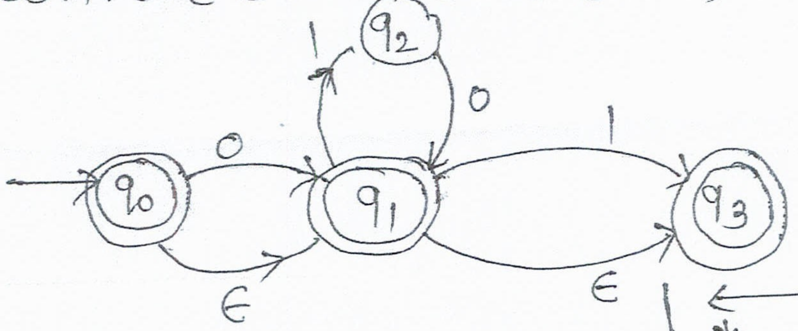
$S \to ABS / AB$

$S \to BAS / BA$

$S \to AA$

Since all are non-terminal / variable symbols on the right hand side. No string can be generated.

Q.5 a) Convert $(0+\epsilon)(10)^*(\epsilon+1)$ into ϵ-NFA and DFA



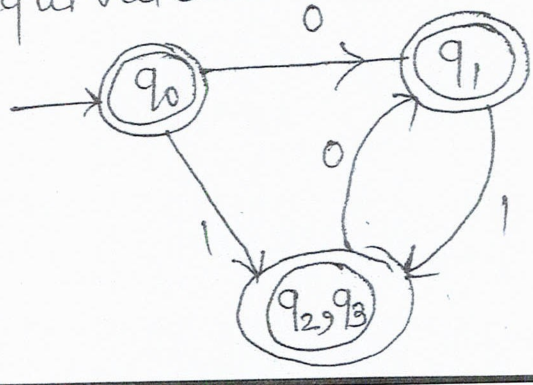
NFA

q	$\delta(q,\epsilon)$	$\delta(q,0)$	$\delta(q,1)$	$\delta^*(q,0)$	$\delta^*(q,1)$
q_0	q_1, q_3	q_1	ϕ	q_1	q_2, q_3
q_1	q_3	ϕ	q_2, q_3	ϕ	q_2, q_3
q_2	ϕ	q_1	ϕ	q_1	ϕ
q_3	ϕ	ϕ	ϕ	ϕ	ϕ

NFA to DFA

	0	1
q_0	q_1	q_2, q_3
q_1	ϕ	q_2, q_3
q_2, q_3	q_1	ϕ

equivalent DFA is :



Q.5

b) PDA to accept $L = \{a^{n-1} b^{2n+1} \mid n \geq 1\}$

$$\delta(q_0, a, Z_0) = (q_0, aZ_0)$$
$$\delta(q_0, a, a) = (q_0, aa)$$
$$\delta(q_0, b, Z_0) = (q_1, Z_0)$$
$$\delta(q_1, b, Z_0) = (q_2, Z_0)$$
$$\delta(q_2, b, Z_0) = (q_3, Z_0)$$
$$\delta(q_3, \epsilon, Z_0) = (q_9, Z_0)$$
$$\delta(q_0, b, a) = (q_4, a)$$
$$\delta(q_4, b, a) = (q_5, \epsilon)$$
$$\delta(q_5, b, a) = (q_4, a)$$
$$\delta(q_5, b, Z_0) = (q_6, Z_0)$$
$$\delta(q_6, b, Z_0) = (q_7, Z_0)$$
$$\delta(q_7, b, Z_0) = (q_8, Z_0)$$
$$\delta(q_8, \epsilon, Z_0) = (q_9, Z_0)$$