

1A. Obtain a grammar to generate the set of all strings with no more than three a's where $\Sigma = \{a,b\}$
Explain.

1B. Obtain CFG for the language **L** which generates strings of **a**'s & **b**'s which all are palindrome over alphabet **a**'s and **b**'s .Also give parse tree for **aaabbaaa**.

1C. Is the following grammar ambiguous?

S \rightarrow **iCts/iCtSeS/a**

C \rightarrow **b**

2A. Define Chomsky Hierarchy. Convert the following CFG to CNF .

S \rightarrow **ABC/BCa/AbA/BcB**

B \rightarrow **bD/cD/ λ**

D \rightarrow **ABD/BCD**

2B. What is Greibach Normal Form. Convert the following grammar to GNF

S \rightarrow **ABCa/BDCb/cDD**

A \rightarrow **bCD/cDD/AC**

B \rightarrow **bD/ λ**

3A. Simplify the CFG

S \rightarrow **ABc/ BCa/Bc/DE**

B \rightarrow **Da/Aa/ Abb/ λ /D**

D \rightarrow **cD/d/cE/ λ**

E \rightarrow **aE**

3B. Eliminate all unit productions from the grammar

S \rightarrow **A0**

B \rightarrow **11**

A \rightarrow **0 / 12**

4A. Define NPDA. Construct the NPDA to accept the language $L = \{a^n b^{2n} \mid n \geq 1\}$

4B. Construct the NPDA to accept the language $L = \{w \mid w \in (a, b)^* \text{ and } n_a(w) < n_b(w)\}$