Institute Of Technology, Nirma University
B.Tech. (CE) Sem VI
2CS601 Theory of Computation

Tutorial 6

Q-1 Design CFG for the following languages:

a. $\{a^i b^j c^k \mid i = j + k\}$
b. $\{a^i b^j c^k \mid j = i + k\}$
c. $\{a^i b^j c^k \mid j = i \text{ or } j = k\}$
d. $\{a^i b^j c^k \mid i = j \text{ or } i = k\}$
e. $\{a^i b^j c^k \mid i < j \text{ or } i > k\}$
f. $\{a^i b^j \mid i \leq 2j\}$
g. $\{a^i b^j \mid i < 2j\}$
h. $\{a^i b^j \mid i \leq j \leq 2i\}$

Q.2 In each each case, what languages are generated for the following CFGs:

1. S → aSa | bSb | ∧
2. . S → aSa | bSb | a | b
3. . S → aSb | bSa | ∧
4. S → aSa | bSb |aAb | bAa|
   A → aAa | bAb | a | b | ∧
5. S → aS | bS | a
6. S → SS | bS | a
7. S → SaS | b
8. S → aT | bT |∧
   T → aS bS

Q.3 Consider the CFG with productions S → aSbScS | aScSbS | bSaScS | bScSaS | cSaSbS | cSbSaS | ∧. Does this generate the language $\{x \in \{a,b,c\}^* \mid n_a(x) = n_b(x) = n_c(x)\}$? Prove your answer.

Q:4 Convert the following CFG to Chomsky Normal Form:

1. S → aAbB
   A → Ab / b
   B → Ba / a
2. S → aA | bB
   A → bAA | a
   B → BBa | b
3. S →aAC
   A →aB|bAB

B→b
C→c

4. S→0X1Y
   X → 0X | 0
   Y →1Y / 1
5. S → abSab | a | aAAb
   A → bS | aAAb | c

Q:5 Explain the term ambiguity and prove that the following grammar is ambiguous grammar.
S → S+S | S-S| S*S| S-S|a

Q.6 Remove unit productions from the following grammar and generate equivalent grammar:

1. S → ABC | 0
   A → 1
   B → C | 0
   C → D
   D → E
   E → 2
2. S →ABCD|0
   A→ BC|1
   B→C
   C→D
   D→d