PES UNIVERSITY, Bangalore

(Established under Karnataka Act No. 16 of 2013)

Department of Computer Science & Engineering

Automata Formal Languages & Logic

Question Bank - Context Free Grammar

Questions from the Prescribed Textbook

Topic	Exercise No.	Question No's
Context-Free Grammars	**5.1**	**Q7-Q9,Q11,Q15,Q18-25**
Parsing and Ambiguity	**5.2**	**Q-6-Q8,Q12-Q19**
Context-Free Grammars and programming languages	**5.3**	**Q1,Q2**

Extra Questions

1. Construct a context free grammar for $a^n b^m c^k$ where $2n = m$ and $k \geq 2$.

2. Describe the language generated by G=({S,A}, {a,b}, P, S). The set of productions P is given as:
   S->aA|bA
   A->aAa|bAb|aAb|bAa| λ

3. Construct the CFG for the language given by L={$0^i1^j2^k$|i+j=k}.

4. Construct the CFG for the language given by L = {$w_1ca^nb^ma^ib^jw_2$ | w1, w2 ∈{a, b}*, length(w_1)=length(w_2), j = 2i, n ≤ m }.

5. Construct the CFG for the language L= {$a^nb^mc^k$ | n ≠m or m ≠k}.

6. Consider the grammar $S \rightarrow 0B \mid 1A$, $A \rightarrow 0 \mid 0S \mid 1AA$, $B \rightarrow 1 \mid 1S \mid 0BB$. Given the string 1100, find a leftmost derivation and/or a rightmost derivation with corresponding parse trees. Repeat for the strings 001110 and 001101.

7. Given the CFG S->AB| λ , A->aB, B->Sb , construct a derivation tree for *aaabbbbbb*.
8. For the regular expression (011+1)*(01)* obtain a context free grammar.

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9. Give a context-free grammar for the language $L \subseteq \{0,1,]\}*$, where $L = \{x\#y \mid x \neq y^R, |x| = |y|\}$.
   For example, 00#10,101#000 $\in$L but 00#0,11#11 $\notin$L

10. Consider the language $L = \{a^m b^{2n} c^{3n} d^p : p > m, \text{ and } m, n \geq 1\}$.
    (a) What is the shortest string in L?
    (b) Write a context-free grammar to generate L.

11. Give unambiguous grammar for the following languages.
    a. {w| the number of a's and b's in w are equal}
    b. (w| the number of a's is at least the number of b's).

12. Prove the context free grammar is ambiguous.
    S->aSbT|T
    T->aT|bT| λ

13. Is the following grammar ambiguous?
    S->iCtS | iCtSeS | a
    C->b
14. Show that S->SaS|b is ambiguous. Construct an unambiguous equivalent of the grammar.

15. Given the grammar,
    S->P|Q
    P->AA
    A->aAb|ab
    Q->aQb|aRb
    R->bRa|ba
    a. Give description in English of L(G).
    b. Construct the leftmost and rightmost derivation for the string abab.

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16. Let G be a grammar S-> 0B/1A, A->0/0S/1AA, B->1/1S/0BB. For the string 00110101 find its leftmost derivation and rightmost derivation tree.

17. Using the grammar G=(V,T,P,S),with V={S} P={S->S U S|SS|S*|(S)|0|1| λ } ,give the left most derivation and the corresponding parse tree for the strong(0U(10)*1)*.

18. Construct leftmost and rightmost derivations for the strings, if the language is given
    S->AS| ε
    A->aa|ab|ba|bb
    Strings:
    a. aabbba
    b. baabab
    c. aaabbb

19. Construct the parse tree for the string a*(a+b00) for the following CFG using both leftmost and rightmost derivation.
    E → I| E+E | E*E | (E)
    I → a|b|Ia|Ib|I0|I1

20. Construct the parse tree for the string a*(a+a) for the following CFG using both leftmost and rightmost derivation. The CFG is E → E + E | E * E | (E) | a.