Theory of Computation
Course Code: 10B11CI513
ASSIGNMENT – II
Last Date: 30-11-2018

1. a) Discuss ambiguity, left recursion and factoring in context free grammars. Explain how to eliminate each one.
   b) Discuss closure and decision properties of context free languages.

2. What is GNF? Explain in detail. Convert the following grammar to GNF:
   a) $A_1 \rightarrow A_1A_3$ b) $A_2 \rightarrow A_3A_1|b$ c) $A_3 \rightarrow A_1A_2|a$.

3. a) Reduce the grammar S→aAa, A→SB|bcc|DaA, C→abb|DD, E→ac, D→aDA.
   b) What is left recursion? How to eliminate it?

4. a) Convert the given grammar to GNF: i) $A_1 \rightarrow A_1A_3$ ii) $A_2 \rightarrow A_3A_1|b$ iii) $A_3 \rightarrow A_1A_2|a$.
   b) Explain the concept of ambiguity in context free grammars. How to eliminate it?

5. Convert the following grammar into Chomsky normal form:
   S→aA/a /B/c, A→a B/$\in$, B→aA, C→c C D, D→abd.

6. a) What are useless variable in a CFG? How do you find out useless variable in a given CFG? Explain with an example.
   b) Eliminate ambiguity from the following grammar *E*→*E* + *E* / E*E/ (E) / id.

7. What is meant by ambiguous grammar? Test whether the grammar is ambiguous or not?

8. Write a procedure for eliminating '*E*' productions from a given CFG. Eliminate '*E*' productions from the given grammar: S→ABCBCD, A→CD, B→Cb, C→a/*E,* D→bD/ *E*

9. Explain equivalence of CFG and PDA.

10. a) Explain acceptance of language by PDA.
    b) Design a PDA that accepts the language L={w/w has equal no. of a's and b's} over an alphabet {a,b}.

11. a) Explain the terms: PDA and CFL.
    b) Explain equivalence of acceptance by final state and empty stack.

12. a) Convert the following Context Free Grammar to PDA i) S→aA|bB ii) A→aB|a iii) B→b. Verify the string aab is accepted by equivalent PDA.
    b) Explain instantaneous description for PDA.

13. a) Define a PDA. Design a PDA for L={xcx^r *I*$x \in \{a,b\}^*$}. Process the string "abbacabba". Note: x^r stands for reverse of a string x.
    b) What do you mean by an instantaneous description of a PDA? Explain with example.

14. a) When do we say mat PDA is non deterministic? Design a PDA for recognizing the language of palindromes over the input alphabet {a,b}.

b) Distinguish between a DPDA and NPDA.

15. Prove that acceptance by empty stack and by final state is equivalent.