Indian Institute of Information Technology Sri City, Chittoor

Theory of Computation – Spring 2024

Mid 2 Examination

Duration: 90 Minutes

Maximum Marks : 60

- It is a closed book exam.
- No electronic devices, books, any kind of material is allowed.

1. Consider the CFG: $S \rightarrow SbS/a$. Show that this CFG is ambiguous by giving (a) two parse trees for the string *abababa* (b) also give two leftmost derivations for the string (c) also give two rightmost derivations for the string. Note, you should use proper notation. [10 Marks]
2. Design a PDA by empty stack to accept each of the following languages.
   a. $\{0^n1^m0^n \mid m,n \geq 1\}$
   b. $\{0^n1^m0^m1^n \mid m,n \geq 1\}$

   [10 Marks]
3. Convert the following CFG to Chomsky Normal Form (CNF) [10 Marks]

   S → aXbX, X → aY | bY | ε, Y → X | c

   Do all preprocessing steps (like elimination of unit productions etc)

4. Prove that the given CFG is in CNF, then any string of length n can be derived using 2n-1 steps. [10 Marks]

5. For the given CFG apply CYK algorithm to find whether the strings (i) ***baaba*** and (ii) ***abba*** are in the language of the CFG or not

   [10 Mark]

   S -> AB | BC, A -> BA | a, B -> CC | b, C -> AB | a

6. Prove that $L=\{a^nb^nc^n \mid n \geq 0\}$ is not a Context Free Language using Pumping Lemma Theorem. [10 Marks]