

INDIAN INSTITUTE OF TECHNOLOGY KHARAGPUR

Date:FN / AN

Time: 60 min

Full marks: -

No. of students: -

Autumn Semester Quiz 2, 2017

Dept: Computer Science & Engineering

Sub No: CS60005

M.Tech (Core)

Sub Name: **Foundations of Computing Science**

Instructions: Answer all questions. Write all your answers ONLY in the spaces provided.

1. Convert the following Context Free Grammar to Chomsky Normal Form:

$G = (\{S, X, Y\}, \{a, b, c\}, \{S \rightarrow aXbX, X \rightarrow aY \mid bY \mid \epsilon, Y \rightarrow X \mid c\}, S)$

2. Consider the following statements about the context free grammar.

$G = (\{S\}, \{a, b\}, \{S \rightarrow SS, S \rightarrow ab, S \rightarrow ba, S \rightarrow \epsilon\}, S)$

- I. G is ambiguous
- II. G produces all strings with equal number of a's and b's
- III. G can be accepted by a deterministic PDA

Which combination below expresses all the true statements about G (**Explain briefly**)?

- A. I only
- B. I and III only
- C. II and III only
- D. I, II and III

3. Which one of the following statements is FALSE (**Explain briefly**)?

- A. There exist context-free languages such that all the context-free grammars generating them are ambiguous.
- B. An unambiguous CFG always has a unique parse tree for each string of the language generated by it.
- C. Both deterministic and non-deterministic pushdown automata accept the same set of languages.
- D. A finite set of string from one alphabet is always a regular language.

4. Consider the following grammar:

$S \rightarrow aSb \mid Sb \mid \epsilon$

- (a) Give a one-sentence description of the language generated by this grammar.
- (b) Show that this grammar is ambiguous by giving a single string that can be parsed in two different ways. Draw both parse trees.
- (c) Give an unambiguous grammar that accepts the same language as the grammar above.

5. Consider the languages:

$L1 = \{0^i1^j \mid i \neq j\}$. $L2 = \{0^i1^j \mid i = 2j+1\}$.

Which of the languages are context free?

- (A) Only L1 is context free.
- (B) Only L2 is context free.
- (C) Both (A) and (B)

Write the correct option in the space provided. If a language is context free, then write a CFG for it.