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| **National University of Computer and Emerging Sciences, Lahore Campus** | | | | |
|  | **Course:** | **Theory of Automate** | **Course Code:** |  |
| **Program:** | **BS (Computer Science)** | **Semester:** | **Fall 2024** |
| **Topic:** | **Finite Automata** | **Total Marks:** | **100** |
| **Due Date:** | **20th October, 2025 (Google Classroom)** | **Weight** | **%** |
| **Section:** | **3F, 3J, 5J** | **Page(s):** | **1** |
| **Exam:** | **Assignment 2** | **Reg. No** |  |

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| **Instruction/Notes:** | This is handwritten assignment which is to be submitted in google classroom. |

**Q.1** In each case below, say what language (a subset of {a, b}∗) is generated by the context-free grammar with the indicated productions.

1. S → aT | bT | T → aS | bS
2. S → aT | bT T → aS | bS |

**Q.2** Find a CFG generating the given language.

1. The set of odd-length strings in {a, b}\* whose first, middle, and last symbols are all the same.

**Q.3** Find context-free grammars generating each of these languages, and

prove that your answers are correct.

1. {aibj | i ≤ j ≤ 3i/2}
2. {aibj | i/2 ≤ j ≤ 3i/2}

**Q.4** In each case below, show that the grammar is ambiguous, and find an

equivalent unambiguous grammar.

1. S → SS | a | b
2. S → ABA A → aA | B → bB |

**Q.5** Prove that the following languages are non-regular

**a)** L = {ak | k is a prime}

**b)** L = { w | w ϵ {a, b}\*, w = wR}

**c)**  L = {anbmcn | n, m ≥ 0 }

**Q.6** Show that the language of all non-palindromes over {*a, b*} (see Example 4.3) cannot be generated by any CFG in which *S* → *aSa* | *bSb* are the only productions.

**Q.7** Describe the language generated by the CFG with productions

*S* →*ST*   *T*→ *aS* | *bT* | *b*

Give an induction proof that your answer is correct.

**Q.8** What language over {*a, b*} does the CFG with productions

*S* → *aaS* | *bbS* | *Saa* | *Sbb* | *abSab* | *abSba* | *baSba* | *baSab* | *\_*

generate? Prove your answer.