**National University of Computer & Emerging Sciences, Karachi**Fast

**Spring-2024 CS-Department  
Assignment 3**

**Issue Date: May 1, 2024 Due date: May 10, 2024**

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| **Course Code: CS301** | **Course Name: Theory of Automata** |

Instructions:

You must submit the scanned copy of your own handwritten assignment on google classroom within the due date, strong action would be taken on plagiarism cases from straight **zero** in assignment to **Grade F** in course.

Question 1: Let be the following grammar.

G is a natural-looking grammar for a fragment of a programming language, but G is ambiguous. Show that G is ambiguous.

Question 2: Use the Example on page 110 of Sipser 3rd edition book to convert the following grammars into Chomsky normal form.

c)

Question 3: Convert the grammars in Q2 to corresponding PDAs.

Question 4: Short Answers Questions

1. Describe the language accepted by grammar S→abS|a.
2. Describe the language accepted by the grammar S→aSb|λ
3. Write a grammar for , where x = 2y.
4. Write a grammar for , where z = x+2y.

Question 5: Given Pushdown Automata that recognize the following language. Draw simple PDA with its tuple information.

A = {

Question 6: For a given Language B = {

Question 7: For a given Language C = {

Question 8: Consider the following CFG G = (V, ∑, R, S), where V = {S, A, B}, ∑ = {0,1}, The start symbol is S and production rules are defined by R are as follows:

S→0ABb

A→BAS|λ

B→0|1

Question 9: Design the PDA for the Language which supports  **| w** is in (0+1)\*.

Question 10: Design the PDA for the Language of balanced parenthesis. Example (), (()), ((())) etc.

Question 11: Implement a Turing machines, M, that decide the following language over the alphabet

Question 12: Give the sequence of configurations that the Turing machine M, in the above problem, enters when started on the indicated input string.

1. 10001

Question 13: Design a Turing machine to compute the function f(x) = 2x + 3, where x is a non-negative integer. The input is a binary string representing x, and the output should be a binary string representing f(x).

Input: x = 101 (Binary representation)

Expected Output: f(x) = 1101 (binary representation)

Assume: TM has a single Tape and finite number of states.

Provide the transition function or table that defines the machine behavior.