CS-3001: Theory of Automata

Serial No:

Final Exam
(Part II)
Total Marks: 80
Total Time: 2 Hours

Thursday, 29th December, 2022

Course Instructors

Dr Waseem Shahzad, Dr Labiba Fahad, Dr Mehreen Alam

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Signature of Invigilator

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Student Name   Roll No.   Course Section   Student Signature

DO NOT OPEN THE QUESTION BOOK OR START UNTIL INSTRUCTED.

Instructions:

1. This is Part II, the design part of the exam.
2. Attempt all of them. Read the question carefully, understand the question, and then attempt it.
3. No additional sheet will be provided for rough work.
4. After asked to commence the exam, please verify that you have **nine (9)** different printed pages including this title page. There are total of **five (5) questions**.
5. Use permanent ink pens only. Any part done using soft pencil will not be marked and cannot be claimed for rechecking.

	Q-1	Q-2	Q-3	Q-4	Q-5	Q-5	Total
Marks Obtained							
Total Marks	10	10	10	10	10	20	70

Q1. [10 pts] CFG=PDA:

Convert the following CNF to its equivalent PDA using the method CFG=PDA.

$S \longrightarrow BB \mid AB \mid BA \mid AA \mid \Delta$

$A \longrightarrow AA \mid a$

$B \longrightarrow AA \mid BA \mid b$

Q2. [10 pts] PDA:

Construct a PDA for **EVEN PALINDROME = { Δ, aa, bb, aaaa, abba, baab, bbbb, … }**

Q3. [10 pts] PDA:

Design PDA for the language **EQUAL-EQUAL = { Δ, ab, ba, aabb, bbaa, abab, baba, baab, abba, aaabbb, ….}**

Q4. [10 pts] GNF:

Convert to GNF. You must convert to intermediary grammar to get full marks.

S -> AB | Δ

A -> AB | BB | a

B -> AB | a

Q5. [10 pts] Pumping Lemma for CFL:

Prove if $a^n b^n c^n d^n$ is a non-CFL.
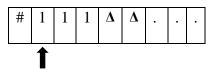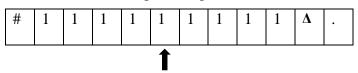
Q6. [20 pts] Computable Functions:

Design a Turing machine that takes input a positive number x and performs the computable function **f(x) = x^2**. Assume the input is in unary notation, the tape head points in the start of the input. However, you may leave the tape head at any location on the output string when the computation is done. You are also **allowed** to use the sub programs of **INSERT** and **DELETE**. You may assume after **INSERT** operation, tape head points at the newly added cell while after **DELETE** operation, tape head points at the same location. An example is given below for your understanding:

Status of tape on input:

#	1	1	1	Δ	Δ	.	.	.

Status of the tape at output:

#	1	1	1	1	1	1	1	1	1	Δ	.

Extra Page: