FAST School of Computing

Fall-2020

Islamabad Campus

CS-301: Theory of Automata

Tuesday, 23rd February, 2021

Course Instructors

Student Name

Dr Waseem Shahzad, Mehreen Alam.

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

(Part II)

Serial No:

	Signature of Invigilator
Section	Signature

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.

Roll No.

- 4. After asked to commence the exam, please verify that you have **thirteen** (13) different printed pages including this title page. There are total of 8 questions.
- 5. Use permanent ink pens only. Any part done using soft pencil will not be marked and cannot be claimed for rechecking.

	1	2	3	4	5	6	7	8	Total
Total Marks	10	10	10	10	10	10	10	10	80
Marks Obtained									

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Q1. **[10 pts]** Convert the following grammar to Chomsky Normal Form Grammar. Show all the intermediary steps in the correct order clearly to score full marks.

S → aAbB | ABC | a

A → aA | a | CD

B → CbC | b

C → CC | ∆

D→CC | Db

E → **EE** | Δ

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Q2. [10 pts] Convert the following grammar to its equivalent Greibach Normal Form.

- S → ab|a
- A →SS|b

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Q3. [10 pts] Use Pumping	Lemma to prove that the f	following language is no	ot Context-Free
$A = \{ 0^n 1$	$m 0^{n} 1^{2n} n,m,k > 0 $		

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Q4. [10 pts] Design a PDA for ODD PALINDROME = { a, b, aaa, aba, bab, bbb, aaaaa, ... }

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[10 pts] Design a Post Machine for the lang	uage a²ⁿbⁿa n for n≥	0.

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10 pts] For the language a²ⁿbⁿc²ⁿdⁿ, whe	ere n≥0, design a 2	2-PDA.

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Q7. **[10 pts]** Let L be some regular language in which all the words happen to have an even length. Let us define the new language Twist(L) to be the set of all the words of L twisted, where by twisted we mean the first and second letters have been interchanged, and so on. For example, if

L = { ba abba babb}
Twist(L) = { ab baab abbb}

Build a Turing Machine that accepts Twist(L). 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. You may leave the tape head at any location on the output string when the computation is done.

Stat	tus	of t	ape	e on	inp	out i	is:							S	tat	us c	of ta	ıре	at t	he o	out	put	is:				
#	а	b	b	b	а	b	а	а	Δ	Δ	Δ				#	b	а	b	b	b	а	а	а	Δ	Δ	Δ	
	1																					<u></u>					

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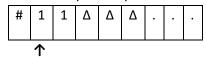
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Q8. **[10 pts]** Design a Turing machine that takes input a non-negative number x and performs the computable function f(x) = 4x. Assume the input is in unary notation, the tape head points in the start of the input. However, you may leave the tape 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 is:



Status of tape at the output is:

		'								
#	1	1	1	1	1	1	1	1	Δ	•
						1				

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