National University of Computer and Emerging Sciences

School of Computing **Fall 2018** **Islamabad Campus**

CS-301Thoery of Automata

Serial No:

Final Exam

Total Time: 2.5 Hours

Total Marks: 90

Monday, Jan 14, 2019

Course Instructor(s)

Dr Waseem Shehzad, Dr Labiba Fahad, Noshina Tariq, Mehreen Alam

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Signature of Invigilator

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Student Name Roll No Section Signature

DO NOT OPEN THE QUESTION BOOK OR START UNTIL INSTRUCTED.

Instructions:

1. Attempt on question paper. Attempt all of them. Read the question carefully, understand the question, and then attempt it.
2. If you need more space write on the back side of the paper and clearly mark question and part number etc.
3. After asked to commence the exam, please verify that you have nine **(9)** different printed pages including this title page. There are a total of five **(5)** questions.
4. 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	Total
Marks Obtained						
Total Marks	**10**	**20**	**20**	**20**	**20**	**90**

Vetted By: _____Vetter Signature: _____

Question 1 [10Marks]

Prove that the language $P = a^n b^n a^n b^n$ is a non-context free language by using self embedded pumping lemma. You must incorporate the concept of self-embedded-ness.

Question 2 [20Marks]

Convert the following grammar to GNF.

S -> Xa | Yb | YYYb
W -> ZZ | SZZ | W | Δ
X -> Sb | b | SZZ
Y -> Sa | a | Z| Δ
Z -> ZZ | SZZ

Question 3 [20Marks]

If TM takes a sequence of numbers as input and leaves only one number as output, we call it a computable function. Build a Turing machine that takes as input two positive numbers and performs the multiplication operation on them, i.e **`mul(3,7)= 21`**. You may use the utilities INSERT and DELETE, if needed. Clearly specify any assumptions and how you are taking the input and leaving the output value.

Question 4 [20Marks]

For the language $\mathbf{a^n b^n c^m d^m}$, solve using n-stack PDA, where n > 1.

Question 5 [20Marks]

Build a Post Machine that takes in any strings of a's and b's and leaves in its STORE the complement that has the a's and b's switched, e.g. on input abab and bbaa, the output left on the STORE is baba and aabb respectively. You are not allowed to use any sub-programs.