Fast**National University of Computer & Emerging Sciences, Karachi  
Spring-2018 CS-Department  
Final Exam  
26nd of December 2018, 9:00 am – 12:00 noon**

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| **Course Code: CS301** | **Course Name: Theory of Automata** |
| **Instructor Name: Shaharbano** | |
| **Student Roll No:** | |

**Instructions :**

* **Return the question paper.**
* **Read each question completely before answering it.**
* **In case of any ambiguity, you may make assumption, but your assumption should not contradict any statement in the question paper.**
* **Start each question on a new sheet.**
* **There are total 9 Questions on 2 Pages.**

**Time: 180 minutes. Max Marks : 120 points**

**Question 1: (5) Points**

**For each of the following choose suitable machines.**

1. **Regular Languages**
2. **Context Free Languages**
3. **WWR**
4. **WW**
5. **Functions**

**Question 2: (10+5+(5+5)) Points**

1. **Construct the DFA A5 for a language upon ∑ ={0,1,2,3,4,5,6,7,8,9} which accepts all strings divisible by 5 .**
2. **Using this DFA construct the DFA AN5 not accepting any strings divisible by 5. Are both DFA's compliment of each other?**
3. **Consider the homomorphism h from the alphabet {0,1,2} to {a,b} defined by : h(0)=ab, h(1)= b, h(2)= aa,**
4. **what is h(0210)?**
5. **if L is the language consisting single string ababb what is (L)**

**Question 3: CFG (5+5) Points**

**Construct a CFG which generates the following languages:**

1. **L1 ={ aibj | 2j≥i}**
2. **L2 ={ anbmcp| n=m+p}**

**Question 4: Ambiguity in CFG (5) Points**

**Give two parse trees of the expression w=abababa from the CFG**

**S → SbS|a**

**Decide if the CFG is ambiguous or not.**

**Question 5: CNF (5+5) Points**

**Consider the following CFG for non empty language:**

**S → ABC|BaB|**

**A → aA | BaC |aaa**

**B → bBb |a |D**

**C → CA|AC**

**D → ε**

1. **Simplify showing each steps clearly with correct ordering.(kindly label your steps neatly)**
2. **Convert the above CFG into CNF.**

**Question 6:** **P.D.A.** **(5+10) Points**

1. **Construct an equivalent P.D.A. by empty stack, from following CFG:**

**S🡪 0TT**

**T🡪 0S|1S|0**

1. **Construct a P.D.A. accepting for the language L ={ aibj ck| i=j or j=k}**

**Question 7:**  **Turing Machines**  **(10+10+5) Points**

1. **Create Turing Machines for the following language and function:** 
   1. **L2 ={0n1m0n1m |n,m≥1}.**

**Show the ID of your TM if the input tape contains 001001.**

* 1. **else write "equal" on the tape if x = y.**

1. **Give an example of infinite loop resulting in Non-Halting TM. Will the TM result in Recursive TM or Recursively Enumerable TM.**

**Question 8: Undecidability & UMT (5+5+5) Points**

1. **Draw the Chomsky hierarchy of languages with the Venn diagram. Also label recursive, recursively enumerable, non recursively enumerable, decidable problems and undecidable problems in the drawn Venn diagram.**
2. **Define Recursive TM, Recursively Enumerable TM, Undecidable Problems.**
3. **If L is a Recursively Enumerable language, is the complement of L Recursively Enumerable? Support your answer.**

**Question 9: (5+5) Points**

**Design a machine for the following**

**L = { (ww| w="welldone") ∪ (ssr| s ="mom"}**

**Argue your machine is best in working regarding Time cost and storage cost.**

***BEST OF LUCK!***