**National University of Computer and Emerging Sciences**

**(Islamabad Campus)**

Department of Computer Science

CS-301 Theory of Automata

Final Exam (Fall 2011)

**PART II**

**Instructor(s):**

Dr. Aftab A. Maroof, Dr. Waseem Shahzad, Ms Mehreen Alam

Dec 17, 2011

**Total Marks: 90 Time Allowed: 2 hours**

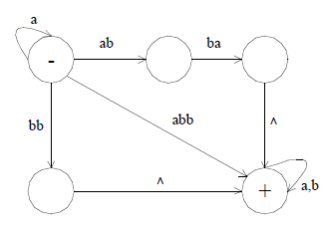
* Exam is divided into two parts. Part I is to be taken on SLATE.
* Part II is followed. The order of both the parts may differ. Some of you would take Part I first while other would take Part II first.
* Examination is closed books/notes. No notes, cheat sheets, textbook, or printed material allowed.
* Make sure you have all the 3 Pages.
* Answer on the answer sheets, separately provided.
* If you believe that some essential piece of information is missing, make an appropriate assumption and use it to solve the problem.

**Roll No: \_\_\_\_\_\_\_\_ Name: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Section: \_\_\_\_\_\_\_\_\_\_\_**

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| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| Question | 1 | 2 | 3 | 4 | 5 | 6 | 7 | 8 | 9 | Total |
| Points | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 10 | 90 |
| Score |  |  |  |  |  |  |  |  |  |  |

Vetted By: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_ Vetter Signature: \_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_

1. Write the regular expression for the language accepted by following TG (Transition Graph). (10)



1. Build a PDA that accepts the language L = an bm am+1 bn+1, where n, m >0. (10)
2. Prove that the language P = anbnanbn is a non-context free language by using pumping lemma for CFGs. (10)
3. Construct a PDA for the following CFG, first convert it to CNF. (10)

S -> Xa | Yb

X -> Sb | b

Y -> Sa | a

1. Build a Turing Machine for the language **{anbn+1}.** (10)
2. Design a Turing machine that takes input two non-negative numbers and performs the **mod** operation on them, for example, **mod(3,7)=3 and mod(7,3)=1**. Clearly specify any assumptions and formats about the input and output of the TM. (10)
3. For the language **anbncndnenfn**, design a 2-stack PDA. (10)
4. 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. ` (10)
5. Briefly answer for the following. (10)
   1. What is the highlighting feature of a Universal Turing Machine(UTM)?
   2. What feature of a Linear Bound Automata (LBA) makes it less powerful than a regular TM?