Summer Term End Examination - July 2013

Class NBR : 1411 **Slot : A+TA**
Course Code : ITE203
Course Title : Theory of Computation

Time : Three Hours **Max.Marks:100**

(With reasons and illustrations wherever needed)

PART - A (8 X 5 = 40 Marks)
Answer ALL Questions

1. Define Non-deterministic Finite Automata (NFA) and discuss how it differs from deterministic finite automata (DFA).
2. Construct a NFA (with λ transitions) for the regular expressions aa*+bb* and (a+b)(a+b)*.
3. State pumping lemma for regular languages and use it to prove that $\{a^n b^m : n < m\}$ is not regular.
4. Define ambiguous and unambiguous grammars. Show that the grammar

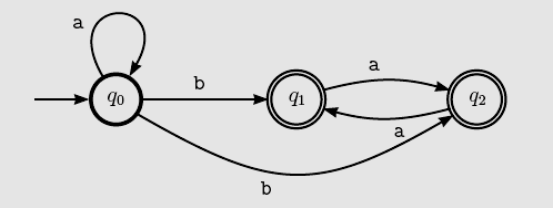
   S → AS | λ, A → 0A1 | 01 | 10, is ambiguous.
5. a) Give a context free grammar for $L_5 = \{a^n b^n : n \geq 0\}$ and draw a parse tree for the string **aabb**. **[2]**

   b) Give a context free grammar for $L_6 = \{w \in \{a,b\}^* :$ no. of a in w = no. of b in w$\}$ and give a leftmost derivation for the string **abbaab**. **[3]**
6. Define a Turing machine and recursively enumerable language.
7. Design a Turing machine to output 0 if a given number n is even and output 1 if n is odd.
8. a) When do you call a problem undecidable. **[2]**

   b) Describe Post Correspondence Problem. **[3]**

PART – B (6 X 10 = 60 Marks)
Answer any SIX Questions

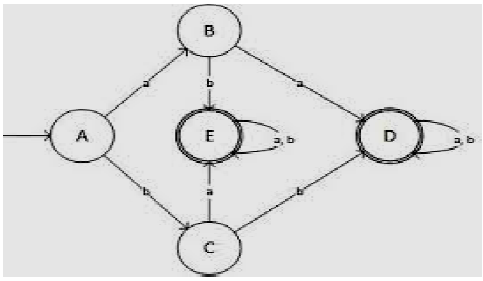
9. a) Convert the following NFA into a DFA and then into a regular expression using Arden's Theorem . **[8]**



b) Write an equivalent regular grammar for the above NFA. **[2]**

10. a) Construct a DFA for strings that do not end with 011. **[5]**

    b) Minimize the following DFA. **[5]**



11. Convert the following grammar into Greibach Normal Form and Chomsky Normal Form.

    $S \rightarrow abAB$, $A \rightarrow bAB \mid \lambda$, $B \rightarrow Saa \mid A \mid \lambda$.

12. a) Show that the language $\{a^n b^n c^n : n > 0\}$ is not context-free. **[7]**

    b) Show that the context-free languages are not closed under intersection. **[3]**

13. Construct a Pushdown automaton (PDA) for the language $\{ww^r : w \in \{a,b\}^*\}$. Describe the working of the constructed PDA for the string **baab** and **aba**.

14. a) Construct a Turing Machine which on given input $x \in \{1\}^*$ outputs 2x. That is for input 111, the output is 111111. **[7]**

    b) Briefly argue whether the above Turing Machine can be extended to perform usual multiplication. **[3]**

15. a) Show that there languages that are not recursively enumerable. **[7]**

    b) Explain the Chomsky hierarchy of languages with their corresponding accepting machines. **[3]**

16. a) Show that the Halting problem is undecidable. **[6]**

    b) Writes short notes on any two variants of Turing Machine. **[4]**

⇔⇔⇔