ANNA UNIVERSITY - UNIVERSITY DEPARTMENT
B.E (FULL TIME) DEGREE EXAMINATION, APR/MAY 2011

Fifth Semester :: Regulation 2008
Branch: Computer Science & Engineering

CS9302 - THEORY OF COMPUTATION
(End-Semester Arrear Examination)

Time: Three Hours Max. Marks: 100

Answer **ALL** Questions

Part A (10 × 2 = 20 Marks)

1. Give a problem that can be solved using second principle of mathematical induction and not by the first principle.
2. When can you say a problem is NP-hard?
3. Define the language recognized by PDA by emptying stack.
4. What do you mean by expressive power of a grammar?
5. State pumping lemma for context free languages.
6. Using pumping lemma, determine whether the language $\{0^n1^n0^n | n \geq 0\}$ is regular or not.
7. Construct a PDA to accept the language $\{(ab)^n | n \geq 1\}$ by empty stack.
8. What is universal language? Why do we call it so?
9. What is the name of the language accepted by Turing Machines? What are its alternate names?
10. When do you say a Turing machine is an algorithm?

Part B (5 × 16 = 80 Marks)

11. (a) Prove that for any language L recognized by an NFA, there exists a DFA to recognize L. (8)

    (b) Give non-deterministic finite automata accepting the set of strings in $(0+1)^*$ such that two 0's are separated by a string whose length is $4i$, for some $i \geq 0$. (8)

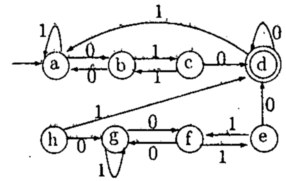
12. (a) i. Prove that there exists an NFA with ϵ-transitions that accepts $L(r)$, for the regular expression r. (8)

    ii. Construct a finite automata equivalent to the regular expression $10 + (00 + 11)0^*1$. (8)

(OR)

    (b) i. State and prove Myhill-Nerode theorem for state minimization. (8)

    ii. Find the minimum state finite automaton equivalent to the following transistion diagram. (8)



13. (a) i. Prove that every non-empty CFL is generated by a CFG with no useless symbols. (10)

    ii. Find a CFG with no useless symbols equivalent to (6)

$$S \rightarrow AB|CA \qquad B \rightarrow AB|BC$$
$$A \rightarrow a \qquad C \rightarrow aB|b$$

(OR)

    (b) i. Suppose $L = N(M)$ for some PDA M, then prove that L is a CFL. (8)

    ii. Give a CFG for the language $N(M)$ where (8)

$$M = (\{q_0, q_1\}, \{0, 1\}, \{Z_0, X\}, \delta, q_0, Z_0, \Phi)$$

and δ is given by

$$\delta(q_0, 1, Z_0) = \{(q_0, XZ_0)\} \qquad \delta(q_0, \epsilon, Z_0) = \{(q_0, \epsilon)\}$$
$$\delta(q_0, 1, X) = \{(q_0, XX)\} \qquad \delta(q_1, 1, X) = \{(q_1, \epsilon)\}$$
$$\delta(q_0, 0, X) = \{(q_1, X)\} \qquad \delta(q_1, 0, Z_0) = \{(q_0, Z_0)\}$$

14. (a) i. State and prove Greibach normal form. (8)

    ii. Find Greibach normal form equivalent to the CFG (8)

$$A_1 \rightarrow A_3A_2|A_2A_3$$
$$A_2 \rightarrow A_3A_3|A_2A_2|a$$
$$A_3 \rightarrow A_2A_2|b$$

(OR)

    (b) i. Design a Turing machine to compute multiplication of two positive integers.

ii. Design a Turing machine to recognize the language $\{0^n 1^n 0^n | n \geq 1\}$

15. (a) Prove that the universal language L_u is r.e. but not recursive.

(OR)

(b) State and prove Rice's theorem for recursively enumerable index sets.

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