Code: 9A05407

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II B. Tech II Semester (R09) Regular & Supplementary Examinations, April/May 2012

FORMAL LANGUAGES & AUTOMATA THEORY

(Computer Science & Engineering)

Time: 3 hours Max Marks: 70

Answer any FIVE questions

All questions carry equal marks

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1 (a) Define string and alphabet and discuss the operations on string.
(b) Define language. Discuss its operations.

2 Prove the theorem "Let M = $(Q,\Sigma, \Delta,\sigma,\lambda,q_0)$ be a Mealy machine then there exists a Moore machine M^1 equivalent to M".

3 (a) Prove "If L is accepted by DFA and then there exists an equivalent regular expression which develops L".
(b) Discuss the method for conversion of regular expression to finite automata.

4 For each of the following languages give a CFG that generates it:
(a) $\{a^ib^jc^k$: i<j or i>k}.
(b) $\{a^ib^j$,: i≤j <=2i}.
(c) $\{a^mb^n$,: m≥n and m-n is even}.

5 (a) What are useless variable in a CFG? How do you find out useless variable in a given CFG? Explain with an example.
(b) Eliminate ambiguity from the following grammar: E → E+E / E*E / (E) / id.

6 Construct CFG for the language recognized by PDA with following moves:

$\delta(q0, 1, Z_0) = (q0, XZ_0)$ $\delta(q0, 1, X) = (q0, XX)$
$\delta(q0, 0, X) = (q1, X)$ $\delta(q0, \epsilon, Z_0) = (q0, \epsilon)$
$\delta(q1, 1, X) = (q1, \epsilon)$ $\delta(q0, 0, Z_0) = (q0, Z_0)$

Simplify the resulting grammar by eliminating useless variables.

7 Define a Turing Machine (TM) and the language accepted by a TM. Design a TM for recognizing the language (a+b)*aba (a+b)*. Draw its transition diagram and table. Using the instantaneous description notation process the string aabaabaaab.

8 (a) Differentiate between NP hard and NP complete complexity of problems. Explain with suitable examples.
(b) Explain about PCP and MPCP in detail.

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1 (a) What is the finite state machine? Define finite automata and discuss the representation of finite automata.
  (b) Discuss the applications of finite automata.

2 Design a Moore and mealy machine for a binary input sequence such that if it has a substring 101 the machine outputs 'A' if input has substring 110 it outputs B, otherwise it outputs C.

3 (a) What are the applications of regular expressions and finite automata?
  (b) Denote a regular expression for the language that accepts all strings in which 'a' appears tripled over the set $\Sigma = \{a\}$ and also construct the finite automata for the same.

4 Prove using the pumping lemma that the following language L is not context – free.
  $L = \{w \neq x: w, x \in \{0,1\}^*$ and w is a prefix of x}.

5 (a) Find out a context free grammar for the language of strings over the alphabet {0, 1} such that the number of 0's are more than the number of 1's in the strings.
  (b) Show that the following grammar is ambiguous: $E \rightarrow E+E / E*E / a$.
  Eliminate the ambiguity from the above grammar using precedence of + is higher than the precedence of * in evaluating the expressions.

6 (a) Design a PDA for recognizing the language of palindromes over the alphabet {0, 1}. Draw the computations tree showing all possible moves for the strings 00100 and 00101.
  (b) Explain the procedure for converting a PDA which accepts a language L by final state into a PDA which accepts the L by empty stack.

7 Define a TM and the instantaneous description of a TM. Design a TM for recognizing $L = \{x \in \{a, b\}^* / x$ ends with aba}. Specify its transition diagram. Process the strings abaaba and ababaa using ID notation.

8 (a) What is universal TM? Explain in detail.
  (b) Write about NP hard and NP complete complexity of problems.

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3

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FORMAL LANGUAGES & AUTOMATA THEORY

(Computer Science & Engineering)

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1 (a) What is NFA? Discuss in detail about NFA.
(b) Distinguish between NFA and DFA.

2 (a) Discuss about the “Equivalence of Moore and Mealy machine”.
(b) Discuss the method for converting the Moore machine to mealy machine.

3 Discuss and prove that the closure properties of regular sets are closed.

4 (a) Construct a grammar for the language L which has all the strings which are all palindrome over Σ= {a, b}.
(b) Differentiate between sentences and sentential forms.

5 (a) If G is a CFG in CNF and x Є L (G) with |x| = k, how many steps are required to derive x in G. Prove your answer.
(b) A variable A in a CFG is said to be reachable if S ==>* α A β. Develop a procedure for finding out reachable variable in a given CFG. Illustrate your procedure with an example.

6 (a) When do we say that a PDA is non deterministic? Design a PDA for recognizing the language of palindromes over the input alphabet {a, b}.
(b) Distinguish between a DPDA and NPDA.

7 (a) Design a TM for recognizing the language of palindromes over the input alphabet {a, b}. Show the moves of TM for the string abbbba.
(b) What is instantaneous description of a TM? Briefly explain.

8 (a) Write in detail about Turing reducibility with examples.
(b) Explain about PCP and MPCP with suitable examples.

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4

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FORMAL LANGUAGES & AUTOMATA THEORY

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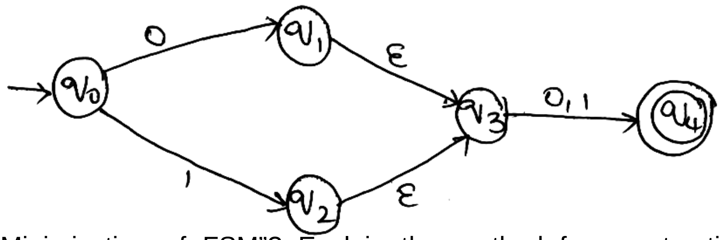
1 (a) Design NFA accepting all strings ending with 101 over $\Sigma = \{0, 1\}$.

(b) Construct a NFA in which triple '1' is followed by triple '0' over $\Sigma = \{0, 1\}$.

2 (a) Convert the given NFA with Σ to its equivalent DFA.



(b) What is the "Minimization of FSM"? Explain the method for construction of minimum state automata.

3 Write R.E for the following and explain:

(a) All strings over {0, 1} with the substring '0101'.

(b) All strings beginning with '11' and ending with ab.

(c) Set of all strings over {a, b} with 3 consecutive b's.

(d) Set of all strings that end with '1' and has no substring '00'.

4 Discuss and explain the following:

(a) CFL is not closed under intersection and complementation.

(b) A regular grammar generates an empty string.

(c) A regular language is also context free but not reverse.

5 (a) Show that $L = \{a^p \,/\, p \text{ is a prime number}\}$ is not a CFL.

(b) Show that every context free language without Є, can be generated by a context free grammar in which all productions are of the form $A \rightarrow a$ and $A \rightarrow a\alpha b$.

6 (a) Construct a PDA for recognizing the language of all strings over the input alphabet {a, b} such that the number of b's in each string are twice the number of a's. Show the moves of the PDA for the string abbabbbba.

(b) Write a short note on NPDA and DPDA's.

7 (a) Define recursively enumerable languages and recursive languages. Prove that the union of two recursive languages is also recursive.

(b) Design a TM for computing the square of a given positive integer. Show the moves of the TM for a value of 2.

8 (a) Discuss about the classes of the computational complexity for problems in detail.

(b) Explain about PCP and MPCP with suitable examples.

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