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M S RAMAIAH INSTITUTE OF TECHNOLOGY

(AUTONOMOUS INSTITUTE, AFFILIATED TO VTU)

BANGALORE – 560 054

SEMESTER END EXAMINATIONS – MAY / JUNE 2013

Course & Branch	: **B.E.- Information Science and Engg**	**Semester**	: **IV**
Subject	: **Finite Automata and Formal Languages**	**Max. Marks**	: **100**
Subject Code	: **IS406**	**Duration**	: **3 Hrs**

Instructions to the Candidates:

- Answer one full question from each unit.

UNIT – I

1. a) Define the following terms: (05)
   i) Alphabet. ii) Power of an Alphabet. iii) Language. iv) ε- Closure.

   b) Design a deterministic finite automata for the following languages on $\Sigma=\{0,1\}$ (08)
   i) $L= \{ (01)^i 1^{2j} \mid i\geq 1 , j\geq 1\}$

   ii) L ={W | W is a even number represented in binary}

   c) Prove that if L=L(A) for some DFA A, then there is a regular expression R such that $L = L(R)$ (07)

2. a) Define Nondeterministic Finite Automata (NFA). Let M = (Q, Σ, δ, q_0, F) be ϵ-NFA defined by: (08)
   $Q= \{q_0, q_1, q_2, q_3, q_4\}$
   $\Sigma = \{a, b\}$
   $F = \{q_4\}$
   δ as follows:

   $\delta(q_0,\epsilon) = \{q_1\}$ $\quad \delta(q_1, \epsilon) = \{ q_1, q_3 \}$ $\quad \delta(q_3, \epsilon) = \emptyset$ $\quad \delta(q_2, \epsilon) = \emptyset$
   $\delta(q_4, \epsilon) = \{ q_3 \}$ $\quad \delta(q_0, a) = \emptyset$ $\quad \delta(q_4, b) = \emptyset$ $\quad \delta(q_3,a) = \{q_4\}$
   $\delta(q_0, b) = \{ q_2 \}$ $\quad \delta(q_1, b) = \emptyset$ $\quad \delta(q_3, b) = \emptyset$ $\quad \delta(q_2, a) = \emptyset$
   $\delta(q_4, a) = \emptyset$ $\quad \delta(q_2, b) = \{q_4\}$ $\quad \delta(q_1, a) = \{q_0, q_4\}$

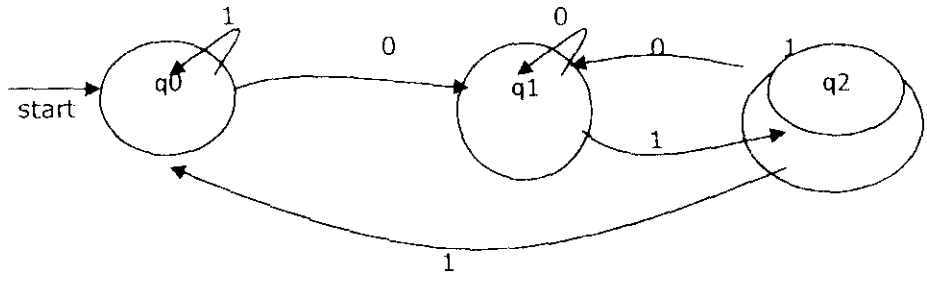
   (i) Write the transition diagram of M.

   (ii) Convert it into DFA

   b) Define regular expression. Write regular expressions for the following languages on $\Sigma=\{0,1\}$ (06)
   i) String with odd number of 1's.

   ii) String containing both 11 and 010 as substring.

c) Obtain the regular expression for the following FA by using state elimination technique. (06)



UNIT – II

3. a) Describe the application of regular expression in Unix. (05)
   b) State and prove the pumping lemma of regular language and show that the language $L=\{ WW^R \mid W \in \{0,1)^*\}$ is not regular. (09)
   c) Define the following terms: (06)
      i) Distinguishable states
      ii) Reversal of string
      iii) Homomorphism

4. a) Prove that the regular languages are closed under intersection. (07)
   b) Consider the following languages defined over $\Sigma=\{0,1\}$ (08)
   $L_1=\{$ The set of all string containing atleast one 0$\}$ and
   $L_2=\{$ The set of all string containing atleast one 1 $\}$
      i) Draw the DFA for the L_1 and L_2
      ii) Draw the DFA to recognizing the languages $L_1 \cup L_2$, $L_1 \cap L_2$, $L_1 - L_2$
   c) Minimize the following DFA by using the table filling algorithm. (05)

δ	0	1
→ A	B	C
B	C	E
*C	D	C
D	C	E
*E	B	E

UNIT – III

5. a) Define context free grammar. Write a context free grammar for the language $L=\{ a^ib^jc^k \mid i=j$ or $j=k\}$ and generate the leftmost derivation for the string "aabb" (08)
   b) Mention the application of context free grammar. Describe any one among them. (05)
   c) Show that the grammar given below is ambiguous. (07)
   $E \rightarrow E+E \mid E*E \mid id$
   Give unambiguous grammar for the above grammar such that + has highest priority, * has less priority and both are right associative.

6. a) What are useless symbol? Eliminate useless symbols and productions from the following grammar. (06)

$S \rightarrow abA \mid bB$
$A \rightarrow aA \mid d$
$B \rightarrow bB$
$D \rightarrow ab \mid Ea$
$E \rightarrow aC \mid a$

b) Convert the following grammar to chomsky normal form. (06)

$S \rightarrow ASB \mid \varepsilon$
$A \rightarrow aAS \mid a$
$B \rightarrow SbS \mid A \mid bb$

c) State and prove the pumping lemma for context free languages. (08)

UNIT – IV

7. a) Prove that the context free languages are closed under union, concatenation and reversal. (08)

b) Define PDA. Design a PDA to accept the following languages by final states, $L = \{a^n c^m b^n \mid m, n \geq 1\}$. Draw the graphical representation of PDA. Also, show the moves made by the PDA for the string "aacccbb" (12)

8. a) Define the following term: (06)

i) Language of PDA.

ii) Instantaneous Description.

iii) Deterministic pushdown automata.

b) Convert the following PDA to CFG :- (08)
$P = (\{p, q\}, \{0,1\}, \{X,Z\}, \delta, q, Z)$

Transition function δ is defined by:
$\delta(q, 1, Z) = \{(q, XZ)\}$

$\delta(q, 1, X) = \{(q, XX)\}$

$\delta(q, \varepsilon, X) = \{(q, \varepsilon)\}$

$\delta(q, 0, X) = \{(p, X)\}$

$\delta(p, 1, X) = \{(p, \varepsilon)\}$

$\delta(p, 0, Z) = \{(q, Z)\}$

c) Find the language accepted by PDA $P = (\{p, q, r\}, \{0,1\}, \{X,Z\}, \delta, p, Z, r)$ (06)
With the transitions :-
$\delta(p, 0, Z) = \{(p, XZ)\}$

$\delta(p, 0, X) = \{(p, X)\}$

$\delta(p, 1, X) = \{(q, \varepsilon)\}$

$\delta(q, \varepsilon, Z) = \{(r, Z)\}$

UNIT – V

9. a) With a diagram, explain the working of a Turing machine. (06)

   b) Design a turing machine to accept even length palindromes over {0, 1}*. Also, write its transition diagram and give instantaneous descriptions for the input "0110" (14)

10. a) Explain the general structure of multi tape machines. Show that they are equivalent to standard turing machine. (10)

    b) Write short notes on : (10)

       i) Multistack Turing machine.

       ii) Nondeterministic Turing machine.

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