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M S RAMAIAH INSTITUTE OF TECHNOLOGY

(AUTONOMOUS INSTITUTE, AFFILIATED TO VTU)

BANGALORE – 560 054

SEMESTER END EXAMINATIONS – MAY / JUNE 2014

Course & Branch	:	**B.E. – INFORMATION SCIENCE & ENGG.**	**Semester**	:	**IV**
Subject	:	**Finite Automata and Formal Languages**	**Max. Marks**	:	**100**
Subject Code	:	**IS416**	**Duration**	:	**3 Hrs**

Instructions to the Candidates:

- Answer one full question from each unit.

UNIT – I

1. a) Define the terms with an example for each: Є-closure, Alphabet, Strings and Language (10)

   b) Write the regular expressions for the following languages: (10)

   i. L_1={x | x has either 001 as substring or 11 as a substring}.

   ii. L_2={xЄ{0,1}* | x has the first and the last bit the same}.

   iii. L_3=Set of all strings over {a, b, c} in which ac does not occur as a substring.

   iv. L_4=Set of binary strings with exactly one pair of consecutive 0's in them.

   v. L_5=Set of binary strings containing no more than two 0's.

2 a) Design a DFA to accept the following languages: (05)

   i. Strings of 0's and 1's with even number of 1's and the number of 0's are multiples of 3.

   ii. Strings of 0's and 1's with odd number of 1's.

   b) Define ε-NFA. Consider the following ε-NFA: (10)

δ	a	b	ε
→ q0	q1	Ø	-
*q1	q1	Ø	q2
q2	Ø	q0	-

   i. Compute the ε-closure of all the states

   ii. Convert it into its equivalent DFA

   c) Define the language of NFA and bring out the applications of DFA. (05)

UNIT - II

3. a) Define string homomorphism with an example. Prove that "If L is a regular language over alphabet Σ, and h is a homomorphism on Σ, then h(L) is also regular" (10)

   b) Convert the following regular expressions to automata: (10)

   i. (aa)*(bb)* + a(aa)*b(bb)*

   ii. (a+b)*cd*e

   iii. (ab+c*)*b

   iv. a*+b*+c*

4. a) Define the term "distinguishable states". Minimize the following DFA: (10)

Δ	0	1
→ q0	q1	q3
q1	q2	q4
q2	q1	q4
q3	q2	q4
*q4	q4	q4

b) Prove that if L=L(A) for some DFA A, then there is a regular expression R such that L=L(R). (10)

UNIT – III

5. a) Define Context Free Grammar (CFG) providing descriptions to its components. Write the CFG for the following languages: (10)
   i. $L(G_1)=\{w \in \Sigma^* \mid |w|$ and w has equal number of a's and b's$\}$
   ii. $L(G_2)=\{a^n b^m \mid n \quad m-1\}$

b) State and prove the pumping lemma for context free languages. (10)

6. a) Consider the grammar: (10)
S → ABC | BaB
A → aA | BaC | aaa
B → bBb | a | D
C → CA | AC
D → ε

   i. Eliminate ε-productions.
   ii. Eliminate any unit productions in the resulting grammar.
   iii. Eliminate any useless symbols in the resulting grammar.
   iv. Put the resulting grammar into Chomsky Normal Form.

b) Explain the following with an example for each: (10)
   i. Constructing Parse trees
   ii. Leftmost and Rightmost derivation
   iii. The Yield of a Parse tree

UNIT – IV

7. a) With a neat diagram, explain the working principle of PDA. Construct NPDA that accepts the language $L=\{a^n b^m \mid n \quad m \quad 3n\}$ on Σ {a,b}. (10)

b) If L=L(M) for some NPDA M, then L is a context free language. (10)

8. a) Define the language of PDA by final state and by empty stack. (04)

b) Let L1 be a context free language and L2 be a regular language. Then prove that L1 ∩ L2 is also context free language. (08)

c) Convert the following grammar to its equivalent PDA. (08)
S → aA

A → aABC | bB | a

B → b

C → c

UNIT - V

9. a) Give the formal definition of Turing Machine. Design a Turing machine, M to accept the language $L(M)=\{0^n1^n \mid n \quad 1\}$ and trace the same for the string 0011. (12)

   b) Prove that "Every language accepted by multi tape TM is recursively enumerable". (08)

10. a) Write short notes on: (10)
    i. Multitape turing machine
    ii. Halting problem of turing machine

    b) Define the language of a Turing machine. Design a Turing machine to compute the function monus(Proper subtraction) and is defined by m monus n = max(m-n, 0). (10)

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