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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Information Science and Engineering

Semester End Examination; May / June - 2018

Finite Automata and Formal Languages

Time: 3 hrs *Max. Marks: 100*

***Note**: Answer **FIVE** full questions, selecting **ONE** full question from each unit.*

UNIT - I

1 a. Define the following with example: 4

i) Kleene closure ii) Language

b. Construct a DFA which accepts strings of 0's and 1's where the value of each string is represented as a binary number. Only the strings representing zero modulo five should be accepted. For example 0000, 0101, 1010, 1111 etc should be accepted. 8

c. Design the DFA for the following languages over $\sum\{a,b\}$ 8

$i)\quad L=\{wbab \mid w\in\{a,b\}^*\}$ $ii)\quad L=\{w: n_a(w)\geq 1, n_b(w)=2\}$

2 a. Explain the applications of Finite Automata. 6

b. Convert the following NFA shown in Fig. 2(b) to its equivalent DFA using lazy evaluation method. 6

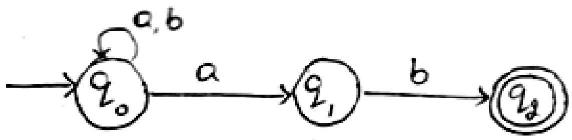
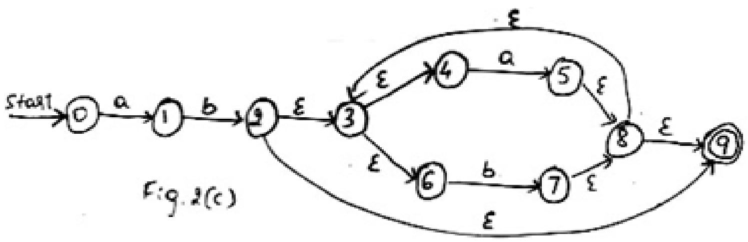


Fig. 2(b)

c. Construct a DFA from the NFA shown in Fig. 2(c) 8



UNIT - II

3 a. Write the regular expression for the following languages : 8

i) Strings of a's and b's of length ≤ 10

ii) Strings of 0's and 1's are having no two consecutive zero's

iii) Strings of a's and b's with two or more letters but beginning and ending with same letter

iv) $L=\{a^{2n}b^{2m} \mid n\geq 0,\ m\geq 0\}$

b. Prove that there exists a Finite Automata to accept the language L(R) corresponding to the regular expression. 6

c. Obtain a regular expression for the Finite Automata shown in Fig.3(c) using state elimination method. 6

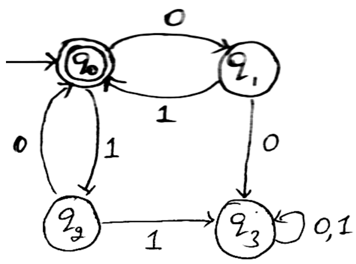


Fig. 3(c)

4 a. List and explain the applications of regular expressions. 4

b. Shown that the following language is not regular : 10

$L = \{ww^R \mid w \in (0+1)^*\}$ $L = \{O^n \mid n \text{ is prime}\}$

c. Show that if L is a regular language, then the complement of L denoted by $\overline{L}$ is also regular. 6

UNIT - III

5 a. Explain the Chomsky hierarchy with an example. 12

b. Write a grammar to generate an arithmetic expression using the operators +, -, *, / and ^. An identifier can start with any of the letters from {a, b, c} and can be followed by zero or more symbols from {a, b, c}. 4

c. Is the following grammar ambiguous? 4

$S \rightarrow aS \mid X$

$X \rightarrow aX \mid a$

6 a. Eliminate the useless symbols in the grammar: 8

$S \rightarrow$ aA | bB

A $\rightarrow$ aA | a

B $\rightarrow$ bB

$D \rightarrow ab \mid Ea$

$E \rightarrow aC \mid d$

b. Convert the following grammar into GNF: 12

$S \rightarrow$ AB1 | 0

A $\rightarrow$ 00A | B

B $\rightarrow 1A1$

UNIT - IV

7 a. Construct a PDA to accept the language 12

$L(M) = \{wCw^R \mid w \in (a+b)^*\}$

Where w^R is reverse of w by a final state. Show the acceptance of the string aabCbaa.

b. Design a PDA to accept the language 8

$L = \{w \mid w \in (a+b)^* \text{ and } n_a(w) = n_b(w)\}$

by an empty stack.

8 a. Obtain a PDA to accept a string of balanced parentheses. The parentheses to be considered are (,), [,]. 10

b. Convert the following grammar into PDA : 10

$$S \rightarrow aABB \mid aAA$$
$$A \rightarrow aBB \mid a$$
$$B \rightarrow bBB \mid A$$
$$C \rightarrow a$$

UNIT - V

9 a. Explain the Turing machine model with a neat diagram. 8

b. Design a Turing machine model to accept the language 12

$$L = \left\{a^n b^n \mid n \geq 1\right\}$$

10 a. Construct a Turing machine to accept the language 8

$$L = \{w \mid w \in (0+1)^*\}$$

Containing the substring 001.

b. Describe a multi-tape Turing machines. 6

c. Explain the Post's correspondence problem with an example. 6

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