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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 - 2019

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 :

i) Alphabets ii) Strings iii) Language 4

b. Compare NFA and DFA. Also explain the applications of Finite Automata. 6

c. Construct a DFA over $\Sigma = \{a, b\}$, where the language is the set of strings such that, the number of *a*'s is divisible by five and the number of *b*'s is divisible by 3. 10

2 a. Prove that, If $D = \{Q_D, \Sigma, \delta_D, \{q_0\}, F_D\}$ is the DFA constructed from NFA $N = (Q_N, \Sigma, \delta_N, q_o, F_N)$ by the subset construction then L(D) = L(N). 10

b. Consider the following $\in$-NFA : 10

δ	∈	a	b	c
->p	{q, r}	Φ	{q}	{r}
q	Φ	{p}	{r}	{p, q}
*r	Φ	Φ	Φ	Φ

i) Identify the $\in$-closure of each state

ii) Give all the strings of length three or less accepted by the automation

iii) Convert the automation to DFA

UNIT - II

3 a. Prove that every language defined by a regular expression is also defined by a finite automation. 10

b. Consider the following NFA and construct the equivalent regular expression by using state elimination method. 10

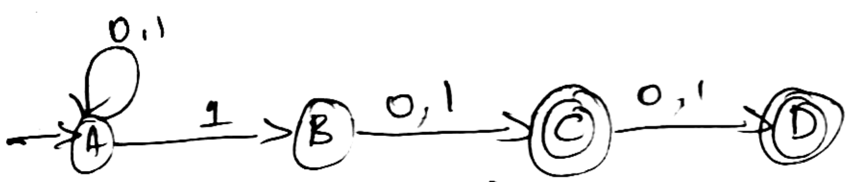

Fig. 3(b)

4 a. If h is a homomorphism from alphabet Σ to alphabet T, and L is a RL over T, the $h^{-1}(L)$ is also a regular Language. Prove this. 10

b. State and prove pumping lemma for regular language. 10

UNIT - III

5 a. Obtain CFG for the following : 9

i) $\{a^i b^j c^k \mid i, j, k \geq 0$ and $i + j = k\}$

ii) $\{w \in \{0, 1\}^* \mid w = w^R$ and $|w|$ is even$\}$

iii) $\{w \in \{0, 1\}^* \mid w$ contains at least three 1's$\}$

b. Show that the given grammar is ambiguous $S \rightarrow aS \mid aSbS \mid \in$ 5

c. Discuss applications of CFG. 6

6 a. Consider the grammar : 12

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

i) Eliminate $\in$ - productions ii) Eliminate unit productions

iii) Eliminate useless symbols iv) Put the grammar into Chomsky Normal form

b. Prove that CFLs are closed under closure and reversal. 8

UNIT - IV

7 a. Define PDA. Design a PDA by empty stack method to accept the language; 10

$L = \{w\, w^R \mid w \in \{a, b\}^*\}$

b. Define the languages of a PDA, accepted by final state and acceptance by empty stack. Also design PDA to accept $L = \{a^i b^j c^k \mid i = j \text{ or } j = k\}$ 10

8 a. Convert the following grammar into PDA : 10

$I \rightarrow a \mid b \mid I_a \mid I_b \mid I_0 \mid I_1$ $E \rightarrow I \mid E*E \mid E+E \mid (E)$

b. Define deterministic PDA and construct DPDA for accepting, 10

$L=\{ wCw^R \mid w \in (a+b)^*$ and w^R is reverse string of $w\}$

UNIT - V

9 a. Design a turing machine to accept the language $L = \{0^n 1^n \mid n \geq 1\}$. 10

b. Write a note on multitape TM and non-deterministic TM. 10

10 a. Explain universal turing machine with its operations. 10

b. Design a TM to implement the fucntion "multiplication " that is TM will start with $0^m 1 0^n$ on its tape and will end with 0^{mn} on the tape. Also outline its strategy. 10

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