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18CS54

Fifth Semester B.E. Degree Examination, June/July 2024
Automata Theory and Computability

Time: 3 hrs.

Max. Marks: 100

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1   a.   Define the following terms with examples:
         i) Alphabet   ii) String   iii) Language   iv) Power of alphabet   v) Σ^* **(08 Marks)**
    b.   Design DFSM for the following languages:
         i) L = {W in {a, b}* : string W end with abb }
         ii) L = {W in {0, 1}* : string W being with 01}
         iii) Set of all strings of 0's and 1's with substring 110   **(12 Marks)**

OR

2   a.   i) Convert the following NDFSM to equivalent DFSM. [Refer Fig.Q2(a)]

Fig.Q2(a)   **(05 Marks)**

         ii) Construct DFSM from the following $\in$-NDFSM.

δ	$\in$	a	b	c
→p	{ q, r }	φ	{ q }	{ r }
q	φ	{ p }	{ r }	{ p, q }
*r	φ	φ	φ	φ

(05 Marks)

    b.   Define Equivalent and Distinguishable pair of states. Construct minimum state DFSM for the following DFSM.

δ	a	B
→ 1	2	4
* 2	3	6
3	2	4
* 4	6	5
5	2	4
6	6	6

(10 Marks)

Module-2

3   a.   Define Regular Expression. Design Regular Expression for the following Languages.
         i) L = {a^m b^n : (m + n) is even }
         ii) L = {a^m b^n : m ≥ 4, n ≤ 3 }
         iii) Set of all strings of 0's and 1's with atleast one occurrence of 00   **(08 Marks)**
    b.   Prove that Regular Grammar define exactly Regular Language.   **(06 Marks)**
    c.   Convert the following Regular expressions to equivalent FSM.
         (i) $(a + b)^*$ ab   (ii) $(aa)^* + (bb)^*$ **(06 Marks)**

OR

4 a. State and prove pumping theorem for Regular Languages. **(08 Marks)**
   b. Show that $L = \{a^n b^n : n \geq 1\}$ is not Regular Language. **(06 Marks)**
   c. Define Regular Grammar. Design Regular Grammar for the following Languages:
      i) $L = \{W \text{ in } \{a, b\}^* : |W| \text{ is even }\}$
      ii) Set of all strings of a's and b's which end with ab **(06 Marks)**

Module-3

5 a. Design Context Free Grammar for the following languages:
      (i) Set of all strings of a's and b's with equal number of each.
      (ii) $L = \{a^i b^j c^k : k = i + j\}$
      (iii) $L = \{a^{2m} b^n : m \geq 1 \; n \geq 1\}$
      (iv) $L = \{a^n b^n c^n : n \geq 1\}$ **(10 Marks)**
   b. Construct (i) left Most Derivation (ii) Right Most Derivation (iii) Parse tree for the string $W = aaabab$ using the grammar.
      $$S \rightarrow AbB \qquad A \rightarrow aA \mid \in \qquad B \rightarrow aB \mid bB \mid \in$$ **(10 Marks)**

OR

6 a. Define PDA. Design PDA for the following language.
      $L = \{W \text{ in } \{a, b\}^* : n_a(W) = n_b(W)\}$
      Number of a's is same as number of b's
      Write Transition diagram of PDA and instantaneous description of PDA for the input string $W = abba$. **(14 Marks)**
   b. Define CNF. Convert the following grammar to CNF.
      $S \rightarrow ABa \mid a$
      $A \rightarrow aab \mid b$
      $B \rightarrow Ac \mid c$ **(06 Marks)**

Module-4

7 a. Define Turing Machine. Design Turing Machine for $L = \{a^n b^n : n \geq 1\}$
   b. Write transition diagram of T.M and also write sequence of ID's of T.M for the input string $W = aabb$. **(14 Marks)**
   c. Explain the model of Linear Bounded Automata with a diagram. **(06 Marks)**

OR

8 a. Explain different techniques of Turing Machine Construction. **(10 Marks)**
   b. Explain Multitape Turing Machine with a diagram. **(06 Marks)**
   c. Explain Non-Deterministic Turing Machine. **(04 Marks)**

Module-5

9 a. Explain Post Correspondence Problem. **(07 Marks)**
   b. Explain Halting problem of Turing Machine. **(07 Marks)**
   c. Explain Decidability and Decidable languages. **(06 Marks)**

OR

10 a. Explain Quantum Computers. **(07 Marks)**
   b. Explain Church – Turing Thesis **(06 Marks)**
   c. Explain Class P and Class NP **(07 Marks)**

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