CBCS SCHEME

USN | | | | | | | | | | | **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.

Important Note : 1. On completing your answers, compulsorily draw diagonal cross lines on the remaining blank pages.
2. Any revealing of identification, appeal to evaluator and /or equations written eg, 42+8 = 50, will be treated as malpractice.

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) $L = \{W \text{ in } \{a, b\}^* : \text{string } W \text{ end with abb}\}$
ii) $L = \{W \text{ in } \{0, 1\}^* : \text{string } W \text{ being with } 01\}$
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)]

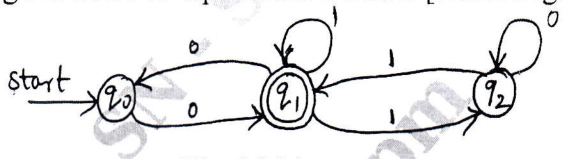

Fig.Q2(a) **(05 Marks)**

ii) Construct DFSM from the following ∈-NDFSM.

δ	∈	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) $L = \{a^m b^n : (m + n) \text{ is even}\}$
ii) $L = \{a^m b^n : m \geq 4, n \leq 3\}$
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.
$S \rightarrow AbB \qquad A \rightarrow aA \mid \epsilon \qquad B \rightarrow aB \mid bB \mid \epsilon$ **(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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