



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

18CS54

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) $L = \{W \text{ in } \{a, b\}^* : \text{string } W \text{ end with } abb \}$
 - 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)

- ii) Construct DFSM from the following ϵ -NDFSM.

δ	ϵ	a	b	c
$\rightarrow p$	{q, r}	ϕ	{q}	{r}
q	ϕ	{p}	{r}	{p, q}
*r	ϕ	ϕ	ϕ	ϕ

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

δ	a	B
$\rightarrow 1$	2	4
* 2	3	6
3	2	4
* 4	6	5
5	2	4
6	6	6

- 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)

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.

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.
 $S \rightarrow AbB \quad A \rightarrow aA \mid \epsilon \quad B \rightarrow aB \mid bB \mid \epsilon$ (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)
