

CBCS SCHEME

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17CS54

Fifth Semester B.E. Degree Examination, June/July 2023 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 with example:
 (i) String (ii) Language (iii) Alphabet (iv) Symbol (04 Marks)
- b. Define Deterministic Finite State Machine (DFSM). Draw DFSM to accept the following language:
 i) $L = \{w \in \{a, b\}^* : W \text{ has all strings that ends with substrings } abb\}$
 ii) $L = \{w \in \{a, b\}^* : W \text{ contains even number of } a\text{'s and off number of } b\text{'s}\}$ (07 Marks)
- c. Convert the following non-DFSM to its equivalent DFSM.

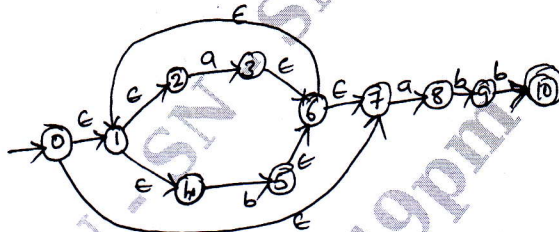


Fig.Q1(c)

(09 Marks)

OR

- 2 a. Define distinguishable and indistinguishable states. Minimize the following DFSM.

δ	a	b
→ A	B	F
B	G	C
* C	A	C
D	C	G
E	H	F
F	C	G
G	G	E
H	G	C

- (i) Draw the table of distinguishable and indistinguishable state for the automata.
- (ii) Construct the minimum state equivalent of automata.

(10 Marks)

- b. Write difference between DFSM and NDFSM and ϵ -NDFSM with example. (05 Marks)
- c. Convert the following NDFSM to DFSM using subset construction method.



Fig.Q2(c)

(05 Marks)

Module-2

- 3 a. Define Regular Expression. Write RE for the following languages:
 i) Strings of a's and b's whose length is 2
 ii) Set of strings consisting of even number of a's followed by odd number of b's (05 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.

- b. Construct an ϵ -NFA for the regular expression $ab(a+b)^*$ (05 Marks)
- c. Obtain a RE for the finite automata shown in Fig.Q3(c).



Fig.Q3(c)

(10 Marks)

OR

- 4 a. State and prove that regular languages are closed under complement, intersection, difference. (06 Marks)
- b. State and prove pumping lemma for regular languages. (08 Marks)
- c. Prove that the following language is not regular.
 $L = \{0^n 1^n \mid n \geq 0\}$ (06 Marks)

Module-3

- 5 a. Define Context Free Grammar (CFG). Write a CFG to specify
 (i) Set of all palindromes over $\Sigma = \{a, b\}$ (ii) $L = \{a^n b^{2n} : n \geq 0\}$
 (iii) $L = \{a^n b^{n+1} : n \geq 0\}$ (07 Marks)
- b. Convert the grammar into Chomsky Normal Form (CNF)
 $S \rightarrow aAD$, $A \rightarrow aB \mid bAB$, $B \rightarrow b$, $D \rightarrow d$ (05 Marks)
- c. Obtain left most derivation, rightmost derivation for the string aabbbb and also write a derivation tree. (08 Marks)

OR

- 6 a. Obtain a PDA to accept the language
 $L(M) = \{ww^R \mid w \in \{a, b\}^*\}$
 Draw the graphical representation of the PDA. Show the moves made by this PDA for the string aabbaa. (10 Marks)
- b. Obtain the corresponding PDA for the grammar
 $S \rightarrow aABC$, $A \rightarrow aB \mid a$, $B \rightarrow bA \mid b$, $C \rightarrow a$ (10 Marks)

Module-4

- 7 a. State and prove the pumping lemma theorem for context tree languages. Show that $L = \{a^n b^n c^n \mid n \geq 0\}$ is not context free. (12 Marks)
- b. If L_1 and L_2 are context free languages, then prove that $L_1 \cup L_2$, $L_1 \cdot L_2$ and L_1^* are context free languages. (08 Marks)

OR

- 8 a. Explain with neat diagram, the working of a Turing Machine. (08 Marks)
- b. Design a Turing machine to accept the language $L = \{0^n 1^n : n \geq 1\}$
 Draw the transition diagram and show the moves made by this turing machine for the string 0011. (12 Marks)

Module-5

- 9 a. Briefly explain the techniques for turing machine construction. (10 Marks)
- b. Explain the following :
 (i) Non-deterministic turing machine (ii) Multitape turing machine (10 Marks)

OR

- 10 Write short notes on the following :
 a. Halting problem of turing machine b. The post correspondence problem
 c. Quantum Computers d. Class NP (20 Marks)