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) $L = \{w \in \{a,b\}^* : W$ has all strings that ends with substrings abb$\}$
ii) $L = \{w \in \{a,b\}^* : W$ contains even number of a's and off number of b's$\}$ **(07 Marks)**

c. Convert the following non-DFSM to its equivalent DFSM.

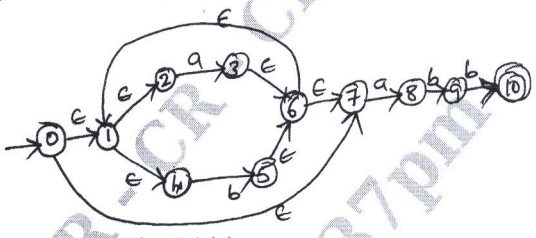

Fig.Q1(c) **(09 Marks)**

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 ∈-NDFSM with example. **(05 Marks)**

c. Convert the following NDFSM to DFSM using subset construction method.

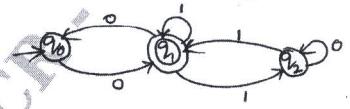

Fig.Q2(c) **(05 Marks)**

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)**

b. Construct an $\in$-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.
$L = \{0^n 1^n / n \geq 0\}$ **(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
$L(M) = \{ww^R / w \in \{a,b\}^*\}$
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)**