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.

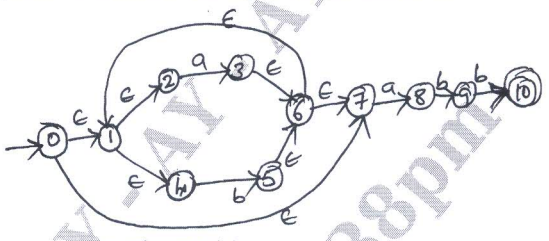

Fig.Q1(c) **(09 Marks)**

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 (05 Marks)
$ab(a+b)^*$

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. (06 Marks)
$L = \{0^n 1^n / | n \geq 0\}$

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) (05 Marks)
$S \rightarrow aAD$, $A \rightarrow aB \mid bAB$, $B \rightarrow b$, $D \rightarrow d$

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 (10 Marks)
$S \rightarrow aABC$, $A \rightarrow aB \mid a$, $B \rightarrow bA \mid b$, $C \rightarrow a$

Module-4

7 a. State and prove the pumping lemma theorem for context tree languages. Show that $L = \{a^n b^n c^n | n \geq 0\}$ 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 : (10 Marks)
(i) Non-deterministic turing machine (ii) Multitape turing machine

OR

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