CBCS SCHEME

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18CS54

Fifth Semester B.E. Degree Examination, Jan./Feb. 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 DFSM. Design DFSM
   i) To accept strings over {a, b} such that each block of 5 (length five) consecutive symbols have atleast two a's.
   ii) To accept L = {ω(ab + ba) | ω ∈ {a, b}* }
   iii) To accept L = {ωbab | ω∈{a, b}* } **(10 Marks)**

b. Define distinguishable and indistinguishable states. Minimize the following DFSM.

δ	0	1
→ A	B	A
B	A	C
C	D	B
* D	D	A
E	D	F
F	G	E
G	F	G
H	G	D

(10 Marks)

OR

2 a. Convert the following NDFSM to DFSM. [Refer Fig.Q2(a)].

Fig.Q2(a) **(08 Marks)**

b. Explain the simulators for Finite State Machine. **(06 Marks)**

c. Design
   (i) Mealy Machine that accepts the string that ends either with aa or bb and Σ = {a, b}
   (ii) Moore Machine that produces 'A', 'B' and 'C' depending on inputs that end with '10', '11' and others respectively. **(06 Marks)**

Module-2

3 a. Build regular expression from the following FSM. [Refer Fig.Q3(a)].

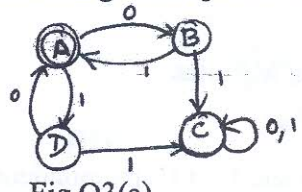

Fig.Q3(a) **(05 Marks)**

b. State and prove pumping Lemma theorem for regular languages. Show that $L = \{a^n b^n \mid n \geq 0\}$ is not Regular. **(10 Marks)**

c. Show that regular languages are closed under complement and intersection. **(05 Marks)**

OR

4 a. Obtain Regular Expression for the following languages.
(i) $L = \{ a^n b^m c^p \mid n \le 4, m \ge 2, p \le 2 \}$
(ii) $L = \{ \omega : |\omega| \bmod 3 = 0 \ \& \ \omega \in \{a, b\}^* \}$
(iii) $L = \{ a^n b^m \mid m + n \text{ is even} \}$ **(08 Marks)**

b. Prove Kleen's theorem – Any language that can be defined with a regular expression can be accepted by some FSM and so is regular. **(08 Marks)**

c. Obtain NDFSM for the following regular expression $(a + b)^* abb$. **(04 Marks)**

Module-3

5 a. Design a PDA for the language
$L = \{ \omega c \omega^R \mid \omega \in (a, b)^* \text{ where } \omega^R \text{ is reverse of } \omega \}$
and show the moves made by PDA for the string "aabcbaa" and "abacbba". **(10 Marks)**

b. Define Leftmost derivation, Rightmost derivation and Parse tree. Consider the grammar.
$S \to AbB \qquad A \to aA \mid \in$
$B \to aB \mid bB \mid \in \qquad D \to a \mid \in$
Obtain LMD, RMD and parse tree for the string "aaabab". **(10 Marks)**

OR

6 a. Define CFG and design a CFG for the following language.
(i) $L = \{0^m 1^m 2^n \mid m \ge 1 \text{ and } n \ge 0\}$
(ii) $L = \{ \omega\omega^R \mid \omega \in (a, b)^* \}$
(iii) $L = \{a^n b^m c^k \mid n+2m = k \text{ for } m \ge 0 \text{ and } n \ge 0 \}$ **(10 Marks)**

b. Define CNF. Convert the following CFG into CNF.
$S \to ASB \mid \in \qquad A \to aAS \mid a \qquad B \to SbS \mid A \mid bb$ **(10 Marks)**

Module-4

7 a. Define TM and design a turing machine for $L = \{\omega \mid \omega \in (0+1)^*$ containing the substring 001$\}$ Write transition diagram and show the moves made by the Turing machine for input string 10010. **(14 Marks)**

b. Define and explain DTM and NDTM. **(06 Marks)**

OR

8 a. With a neat diagram explain the working of Multitape Turing Machine. **(08 Marks)**

b. Design a Turing machine to accept $L = \{0^n 1^n \mid n \ge 1 \}$. Show the moves made for the string 0011 and 00111. **(12 Marks)**

Module-5

9 Write short notes on :
a. Linear Bound Automata **(06 Marks)**
b. Church Turing Thesis **(07 Marks)**
c. Non-Deterministic Turing Machine **(07 Marks)**

OR

10 a. Explain Halting Problem and Post Correspondence problem in Turing Machine. **(10 Marks)**

b. Discuss the following :
i) Decidable and Undecidable Language **(05 Marks)**
ii) Quantum Computers **(05 Marks)**

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