CBCS SCHEME

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15CS54

Fifth Semester B.E. Degree Examination, Feb./Mar. 2022
Automata Theory and Computability

Time: 3 hrs.

Max. Marks: 80

Note: Answer any FIVE full questions, choosing ONE full question from each module.

Module-1

1 a. Define the following with example: (i) Alphabet   (ii) String   (iii) Language   **(06 Marks)**
   b. Draw a DFA to accept string of a's and b's ending with ab or ba.   **(04 Marks)**
   c. Draw a DFA to accept strings of a's and b's such that:
      (i)   Language has even number of a's and odd number of b's.
      (ii) Language has not more than three a's.   **(06 Marks)**

OR

2 a. Define different types of finite state machines.   **(04 Marks)**
   b. Minimize the following Finite state machine.

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

   (06 Marks)

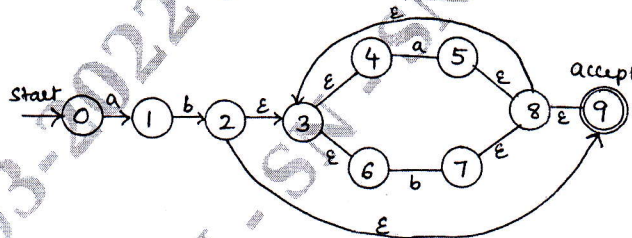   c. Convert the following ε - NFA to its equivalent DFA.

Fig.Q2(c)   **(06 Marks)**

Module-2

3 a. Define Regular expression and write R.E for the following language:
      i) $L = \{a^{2n} b^{2m} \mid n \geq 0, m \geq 0\}$ (ii) $L = \{a^n b^m \mid m \geq 1, n \geq 1, nm \geq 3\}$ **(04 Marks)**
   b. Explain different types of grammars.   **(06 Marks)**
   c. Obtain a FSM from the following grammar:

   $S \rightarrow aT$

   $T \rightarrow bT$

   $T \rightarrow aW$

   $W \rightarrow \varepsilon$

   $W \rightarrow aT$

   and obtain the equivalent regular expression.   **(06 Marks)**

OR

4   a. Define a Regular grammar. Design regular grammars for the following languages:
        (i) Strings of a's and b's ending with ab.
        (ii) Strings of a's and b's having a substring aab.   (06 Marks)
    b. State and prove pumping lemma for regulars languages.   (06 Marks)
    c. Show that $L = \{WW^R \mid W \in (0+1)^*\}$ is not regular using pumping lemma. (04 Marks)

Module-3

5   a. Define context free grammar. Write a context free grammar for the language
        $L = \{a^{n+2} b^m \mid n \geq 0 \text{ and } m > n\}$ (06 Marks)
    b. Define ambiguity of a grammar. Check whether the following grammar is ambiguous or not.
        $S \rightarrow aS|X$
        $X \rightarrow aX|a$ (04 Marks)
    c. Simplify the following grammar:
        $S \rightarrow aA|a|Bb|cC$
        $A \rightarrow aB$
        $B \rightarrow a|Aa$
        $C \rightarrow cCD$
        $D \rightarrow ddd$ (06 Marks)

OR

6   a. Define PDA. Obtain a PDA to accept $L = \{WW^R \mid W \in \{a, b\}^*\}$. Write the transition diagram.   (08 Marks)
    b. Convert the following grammar into equivalent PDA.
        $E \rightarrow E + T$
        $E \rightarrow T$
        $T \rightarrow T * F$
        $T \rightarrow F$
        $F \rightarrow (E)$
        $F \rightarrow id$ (08 Marks)

Module-4

7   a. State pumping lemma for context free languages. Show that $L = \{a^n b^n c^n \mid n \geq 0\}$ is not context free.   (08 Marks)
    b. What is a Turing machine? Explain different ways of representing Turing machines. (08 Marks)

OR

8   a. What is an ID of a Turing Machine? Define the language accepted by a Turing Machine. (04 Marks)
    b. Design a TM to accept the language $L = \{a^n b^n \mid n \geq 1\}$ (06 Marks)
    c. Explain Turing Machine Model.   (06 Marks)

Module-5

9   a. What are the various techniques for TM construction?   (06 Marks)
    b. Derive the following: (i) Recursively enumerable language   (ii) Decidable language. (04 Marks)
    c. What is post correspondence problem?   (06 Marks)

OR

10 a. What is halting problem? Explain.   (04 Marks)
    b. Define the following: (i) Quantum computer   (ii) Class NP   (04 Marks)
    c. Explain Church Turing Hypothesis.   (08 Marks)

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