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17CS54
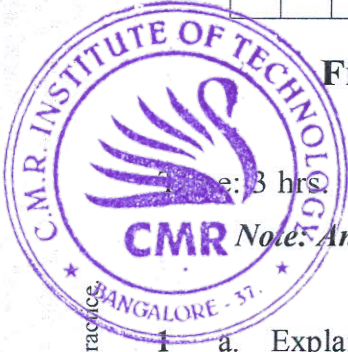
Fifth Semester B.E. Degree Examination, Jan./Feb. 2023
Automata Theory and Computability

Time: 3 hrs.

Max. Marks: 100

Note: *Answer any FIVE full questions, choosing ONE full question from each module.*
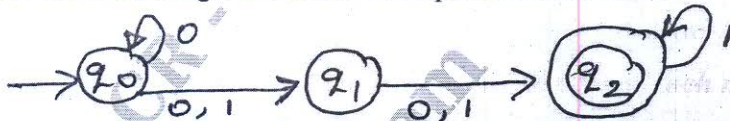
Module-1

1. a. Explain with example,
        i) Strings   ii) Language   iii) Function on string. **(06 Marks)**
    b. With a neat diagram, explain a hierarchy of language classes in automata theory. **(04 Marks)**
    c. Construct DFSM for the following languages:
        i) $L = \{w \in \{a, b\}^* | w$ contains no more than one $b\}$
        ii) $L = \{w \in \{a, b\}^* | w$ contains even number of a's and odd number of b's$\}$
        Give transition table and show that aabaa is accepted. **(10 Marks)**

OR

2. a. Define NDFSM. Convert the following NDFSM to its equivalent DFSM. **(10 Marks)**

    Fig.Q.2(a)

    b. Define distinguishable and indistinguishable states. Minimize the number of states in DFSM.

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

(10 Marks)

Module-2

3. a. Define regular expression. Write regular expression for the following:
        i) $L = \{a^{2n}b^{2m} | n \geq 0, m \geq 0\}$
        ii) $L = \{a^n b^m | m + n$ is even$\}$
        iii) $L = \{a^n b^m | n \geq 1, m \geq 1, nm \geq 3\}$ **(08 Marks)**
    b. Design an NDFSM for the regular expression $a^* + b^* + c^*$. **(06 Marks)**
    c. Obtain a regular expression for finite automata using state elimination. **(06 Marks)**

    Fig.Q.3(c)

OR

4 a. State and prove pumping lemma for regular languages. (08 Marks)

  b. Define regular grammar. Design regular grammar for $\{w \in \{a,b\}^* \mid w \text{ does not contain aa}\}$. (06 Marks)

  c. Prove that regular language are closed under union, concatenation and star. (06 Marks)

Module-3

5 a. Define CFG. Design CFG for the language.

  i) $L = \{0^m 1^m 2^n \mid m \geq 1, n \geq 0\}$

  ii) $L = \{a^n b^{n+2} \mid n \geq 0\}$. (06 Marks)

  b. Define Ambiguous grammar. Consider grammar G with production.
  $S \rightarrow iCtS \mid iCtSeS \mid a, C \rightarrow b$
  Obtain left most derivation, rightmost derivation and parse tree for the string w = ibtibtaea. (08 Marks)

  c. Obtain grammar in CNF
  $S \rightarrow 0A \mid 1B$
  $A \rightarrow 0AA \mid 1S \mid 1$
  $B \rightarrow 1BB \mid OS \mid 0$. (06 Marks)

OR

6 a. Define a PDA. Obtain a PDA to accept $L\{a^n b^n \mid w \in \{a,b\}^*\}$. Draw transition diagram. (10 Marks)

  b. Convert the following grammar to equivalent PDA
  $S \rightarrow aABC$
  $A \rightarrow aB \mid a$
  $B \rightarrow bA \mid b$
  $C \rightarrow a$. (10 Marks)

Module-4

7 a. State and prove pumping lemma for CFL show that $L = \{a^n b^n c^n \mid n \geq 0\}$ is not context free language. (10 Marks)

  b. Define Turing machine. Design TM to accept the language $L = \{0^n 1^n 2^n \mid n \geq 1\}$. Draw the transition diagram and show the moves made by TM for the string 001122. (10 Marks)

OR

8 a. Explain with neat diagram the working of a Turing machine model. (10 Marks)

  b. Demonstrate how L_1 and L_2 are CFL then prove that family of CFL is closed under union, concatenation and star. (10 Marks)

Module-5

9 a. With a neat diagram, explain variants of Turing machine. (10 Marks)

  b. Explain with example: i) Decidability ii) Decidable Languages iv) Undecidable language (10 Marks)

OR

10 a. Discuss Halting problem and post correspondence problem with respect to TM. (10 Marks)

  b. Define non-deterministic TM and prove that there is a deterministic TM 'M' such that $T(M) = T(M_1)$. (10 Marks)

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