Total No. of printed pages = 4

19/5th Sem/UCSE503

2021

FORMAL LANGUAGE AND AUTOMATA THEORY

Full Marks - 100

Time - Three hours

The figures in the margin indicate full marks for the questions.

Answer any five questions.

- (a) Consider the regular expression (ab)*abba.
 Design a non-deterministic finite automata (NFA) that accepts the regular expression.
 - (b) Design an equivalent deterministic finite automata (DFA) for your developed NFA in the previous question.
 - (c) Minimize the DFA.

(d) Given an automaton M, how will identify whether it is a DFA or NFA?

[Turn over

 (a) Consider the following Moore machine and construct an equivalent Mealy machine.

| Present state | Next state | | Output | |
|----------------|----------------|----------------|--------|--|
| Present state | a=0 | a=1 | | |
| → q0 /2 | q | q_2 | .1 | |
| q, /* | q_i | q_3 | 1 | |
| q, / 3/ | q_2 | q ₃ | 1 | |
| ANOLO Q3 | q_s | q ₆ | 0 | |
| q ₄ | q_2 | q ₁ | 1 | |
| q ₅ | q ₅ | q ₆ | 0 | |
| q ₆ | q_2 | q ₆ | 1 | |

(b) Consider the following Mealy machine and construct an equivalent Moore machine. 6

| Present state | a = 0 | | a = 1 | |
|-------------------|------------------|--------|----------------|--------|
| | Next state | Output | Next state | Output |
| $\rightarrow q_0$ | \mathbf{q}_{i} | 1 | q ₂ | 1 |
| q ₂ | q, | 0 | q ₃ | 1 |
| q ₂ | q, | 1 | q _i | 1 |
| q ₃ | q _s | - 1 | q ₄ | 0 |
| q, | q, | 1.2 | q ₂ | 0 |
| q _s | q, | 1 | q, | 0 |

- (c) Write down the regular expression for the following languages on {a, b, c}
 - (i) L1=All strings ends with a followed by b.
 - (ii) L2=All strings having two occurrence of "a" or two occurrence of "c".
 - (iii) L3=All even length string. 2×3=6
- (a) Construct a regular grammar that generates a language a^x b^y c^x, where x, y, z ≥ 0.
 - (b) Write down the pumping lemma for regular language. 4
 - (c) Use your pumping lemma to prove that a language L = a^m, where m = n³ for all n ≥ 0 is not regular.
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- (a) Consider the grammar G and generate an equivalent grammar X without null productions.

$$S \rightarrow aABD$$
, $A \rightarrow BC \mid a \mid \epsilon$, $B \rightarrow b \mid \epsilon$, $C \rightarrow d$, $D \rightarrow d \mid \epsilon$.

(b) Convert your grammar X in to Chomosy's Normal Form and Greibach's Normal Form.

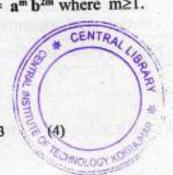
5+5=10

(c) Remove unit productions from the following grammar:

$$S \rightarrow AB \mid a, A \rightarrow D \mid aa, B \rightarrow D \mid b, D$$

 $\rightarrow E \mid d, E \rightarrow e.$

- (a) Write down the pumping lemma for Context Free Grammar.
 - (b) Use the lemma to prove the language $L = a^n b^n c^n d^n$, $n \ge 0$ is not context free language 8
 - (c) Design a PDA which accepts a language L=aⁿ b^m where n>m and n, m ≥ 0. 8
- 6. (a) What do you mean by a problem is undecidable or decidable?
 4
 - (b) What is the halting problem of a Turing machine?
 - (c) Design a Turing machine that accepts a language L= a^m b^{2m} where m≥1.
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