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.

1. (a) Consider the regular expression **(ab)*abba**. Design a non-deterministic finite automata (NFA) that accepts the regular expression. 5

   (b) Design an equivalent deterministic finite automata (DFA) for your developed NFA in the previous question. 8

   (c) Minimize the DFA. 4

   (d) Given an automaton M, how will identify whether it is a DFA or NFA ? 3

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2. (a) Consider the following Moore machine and construct an equivalent Mealy machine. 8

Present state	Next state		Output
	a=0	a=1	
$\rightarrow q_0$	q_1	q_2	1
q_1	q_1	q_3	1
q_2	q_2	q_3	1
q_3	q_5	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
$\rightarrow q_0$	q_1	1	q_2	1
q_1	q_4	0	q_3	1
q_2	q_3	1	q_1	1
q_3	q_5	1	q_4	0
q_4	q_1	1	q_2	0
q_5	q_5	1	q_3	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

3. (a) Construct a regular grammar that generates a language $\mathbf{a^x b^y c^z}$, where x, y, z ≥ 0. 8

(b) Write down the pumping lemma for regular language. 4

(c) Use your pumping lemma to prove that a language $\mathbf{L = a^m}$, where $\mathbf{m = n^3}$ for all n ≥ 0 is not regular. 8

4. (a) Consider the grammar G and generate an equivalent grammar X without null productions.

$S \rightarrow aABD$, $A \rightarrow BC \mid a \mid \in$, $B \rightarrow b \mid \in$, $C \rightarrow d$, $D \rightarrow d \mid \in$. 5

(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 :

$S \rightarrow AB \mid a,\ A \rightarrow D \mid aa,\ B \rightarrow D \mid b,\ D \rightarrow E \mid d,\ E \rightarrow e.$ 5

5. (a) Write down the pumping lemma for Context Free Grammar. 4

(b) Use the lemma to prove the language $L = a^n b^n c^n d^n$, $n \geq 0$ is not context free language 8

(c) Design a PDA which accepts a language $L=a^n b^m$ where $n>m$ and $n, m \geq 0$. 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 ? 4

(c) Design a Turing machine that accepts a language $L= a^m b^{2m}$ where $m \geq 1$. 12