Total number of printed pages: 03

UG/5th /UCSE503 2023

Formal Language and Theory of Automata

Full Marks: 100

Time: Three hours

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

*Answer **Question 1 and any four** questions from the rest.*

Q1. Consider a language $L = a^p b^q c^r d^s$ where $p+q = r+s$, and $p,q,r,s > 0$.

a) Design a Turing Machine for the above-mentioned language.

b) Trace your machine with the input $a^3 b^4 c^6 d^1$.

(15+5)

Q2. Consider the following language and identify their class.

a) $a^p b^q c^r$ where $p, q, r>0$

b) $a^p b^q c^r$ where $p, q, r>0$ and $p = q$

c) $a^p b^q c^r$ where $p, q, r>0$ and $p + q = r$

d) $a^p b^q c^r$ where $p, q, r>0$ and $p > q > r$

(4×5)

Q3.

a) Design a DFA that accepts any string w over the $\sum$ = {a, b} where the numbers of a are multiples of 3 and numbers of b are multiples of 2.

b) Consider the following Mealy machine and convert it to its equivalent Moore machine

Present state	x = 0		x = 1		x = 2	
	Next state	Output	Next state	Output	Next state	Output
→ q_0	q_0	a	q_1	a	q_2	b
q_1	q_2	a	q_0	b	q_3	a
q_2	q_1	a	q_2	b	q_4	b
q_3	q_5	a	q_1	a	q_5	b
q_4	q_3	c	q_0	b	q_5	c
q_5	q_2	b	q_1	a	q_0	c

(10+10)

Q4.

Construct PDA for the following languages –

a)WW^R, where W = {any string of having ***a*** s and ***b*** s }

b)WcW^R where W = {any string of having ***a*** s and ***b*** s }

c) Identify the basic difference between the two different PDAs you have constructed.

(8+8+4)

Q5.

a) Consider the following language –

L1 = Regular

L2 = Context Free

L3 = Context Sensitive

What will be the type of the following languages? Discuss briefly.

i) L1 ∪ L2 ∪ L3

ii) L1 ∩ L2 ∩ L3

iii) L1 ∩ (L2 ∪ L3)

iv) (L1 ∩ L2) ∪ L3)

v) L1 ∪ (L2 ∩ L3)

b) Consider the following Grammar and design a Finite Automaton for it.

A-> aB | a, B->bcdE, , E->eE|f

(15+5)

Q6.

a) Justify the following statement "All recursive languages are recursively enumerable".

b) Consider a Language L is recursively enumerable and its complement L' is also recursively enumerable. Can you conclude more on Language L? (Discuss briefly).

c) Convert the following Grammar into – Greibach and Chomsky's Normal Form

$S \rightarrow aAbBdDeE, A \rightarrow B \mid a \mid \epsilon, B \rightarrow b \mid \epsilon, D \rightarrow d \mid \epsilon$

(5+5+10)

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