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P.E.S. College of Engineering, Mandya - 571 401

(An Autonomous Institution affiliated to VTU, Belagavi)

Fourth Semester, B.E. - Computer Science and Engineering

Semester End Examination; Sep. / Oct. - 2023

Theory of Computation

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:
CO1: Understand the basic concept of Automata.
CO2: Apply the knowledge of Automata Theory for formal Languages
CO3: Analyze automata and their computational power to recognize languages
CO4: Design an automaton.

***Note**: I) **PART - A** is compulsory. **Two** marks for each question.*
*II) **PART - B**: Answer any **Two** sub questions (from a, b, c) for a Maximum of **18 marks** from each unit.*

Q. No.	Questions	Marks	BLs	COs	POs
	I : PART - A	**10**			
1 a.	Write the applications of finite automata.	2	L2	CO1	PO1
b.	Write the applications of regular expressions.	2	L2	CO2	PO1
c.	Define Parse trees.	2	L1	CO3	PO1
d.	Define PDA.	2	L1	CO2	PO1
e.	Explain Turing machine model.	2	L2	CO1	PO1
	II : PART - B	**90**			
	UNIT - I	**18**			
2 a.	List out the differences between DFA, NFA and $\in$-NFA.	9	L2	CO1	PO
b.	Write DFA's for the following languages on $\Sigma = \{a, b\}$ i) Set of all strings ending with *ab* ii) Set of all strings not containing the substring *aab* iii) Set of all strings having "Exactly one *a*"	9	L2	CO2	PO2
c.	Consider the following $\in$-NFA. i) Compute $\in$-closure of each state ii) Give all the strings of length three or less accepted by automata iii) Convert the automata to DFA	9	L3	CO4	PO2
	UNIT - II	**18**			
3 a.	State and prove pumping lemma for regular languages show that the language $L = \{a^n b^n \mid n \geq 0\}$ is not regular.	9	L4	CO2	PO2

δ	$\in$	a	b	c
p	ϕ	{p}	{q}	{r}
q	{p}	{q}	{r}	ϕ
*r	{q}	{r}	ϕ	{p}

b. Minimize the following DFA:

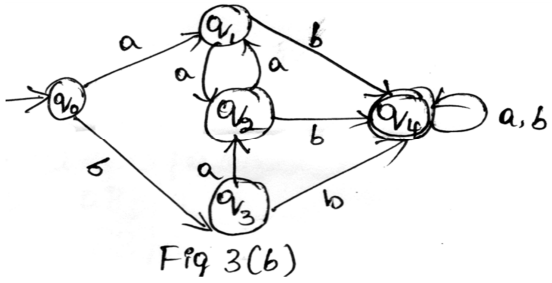

Fig 3(b)

9 L3 CO2 PO2

c. Write regular expression for the following language:

i)$\{\omega \in \{a, b\}^*$ does not end with $ba\}$

ii)$\{\omega \in \{0, 1\}^*$ has substring 001$\}$

iii)$\{\omega \in \{0, 1\}^* |\omega|$ is even$\}$

9 L2 CO1 PO3

UNIT - III **18**

4 a. Consider the grammar:

$S \rightarrow aS|aSbS|\in$

Is the above grammar ambiguous? Show that the string *aab* has two

i) Parse trees

ii) Left most derivations

iii) Rightmost derivations

9 L3 CO3 PO2

b. Convert the following grammar to CNF:

$S \rightarrow 0A|1B$

$A \rightarrow 0AA|1S|1$

$B \rightarrow 1BB|0S|0$

9 L3 CO2 PO2

c. Obtain a CFG to generate the following language:

i) $L = \{a^n b^{n+2}: n \geq 0\}$

ii) $L = \{\omega\omega^R | \omega \in \{a, b\}^*\}$

iii) $L = \{0^m 1^m 2^n | m \geq 1$ and $n \geq 0\}$

9 L3 CO3 PO2

UNIT - IV **18**

5 a. Obtain PDA from the following grammar:

$S \rightarrow aABB|aAA$

$A \rightarrow aBB|a$

$B \rightarrow bBB|A$

$C \rightarrow a$

9 L3 CO2 PO2

b. Design a PDA to accept the language

$L = \{\omega | \omega \in (a+b)^*$ and $n_a(\omega) = n_b(\omega)\}$ and is the PDA is deterministic?

9 L4 CO4 PO2,3

c. Design a PDA to accept the language $L = \{\omega\omega^R | \omega \in (a+b)^*\}$

9 L4 CO4 PO1,2,3

UNIT - V **18**

6 a.	Obtain a Turing machine to accept the language L = $\{0^n1^n \mid n \geq 1\}$	9	L3	CO4	PO1,2
b.	Write short notes on the following: i) Multi-tape Turing machines ii) Non-deterministic Turing machine iii) Undecidable problems	9	L2	CO1	PO1,2
c.	Explain the following terms: i) Recursively Enumerable languages ii) Multi track Turing machine iii) Post correspondence problem	9	L2	CO1	PO1,2

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