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P.E.S. College of Engineering, Mandya - 571 401
(An Autonomous Institution affiliated to VTU, Belagavi)
Fourth Semester, B.E. - Information 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.

<u>*Note:*</u> *I) PART - A is compulsory.* ***Two*** *marks for each question.*

II) PART - B: Answer any <u>***Two***</u> *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.	9	L3	CO4	PO2

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

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

	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

b. Minimize the following DFA:

Fig 3(b)
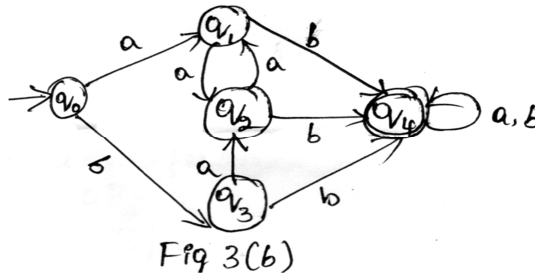
9 L3 CO2 PO2

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→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→0A|1B

A→0AA|1S|1

B→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→aABB|aAA

A→aBB|a

B→bBB|A

C→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 $L = \{0^n 1^n | n \geq 1\}$. 9 L3 CO4 PO1,2

  b. Write short notes on the following:

    i) Multi-tape Turing machines
                                                                    9 L2 CO1 PO1,2
    ii) Non-deterministic Turing machine

    iii) Undecidable problems

  c. Explain the following terms:

    i) Recursively Enumerable languages
                                                                    9 L2 CO1 PO1,2
    ii) Multi track Turing machine

    iii) Post correspondence problem

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