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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; August - 2023
Finite Automata and Formal Languages

Time: 3 hrs *Max. Marks: 100*

Course Outcomes

The Students will be able to:
CO1: Construct regular expression and finite automata
CO2: Analyze regular Language
CO3: Design context free grammars
CO4: Design push down automata
CO5: Design Turing machine

***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
	I : PART - A	**10**		
1 a.	Define regular expression.	2	L1	CO1
b.	Draw an NFA for the RE = ab $(a+b)^*$.	2	L3	CO2
c.	Write a grammar to generate the following language: $L=\{a^n b^n \mid n \geq 1\}$	2	L3	CO3
d.	"Is these any need for pushdown automata when finite automata already exists?" Justify with answer.	2	L2	CO4
e.	Define Turing machine.	2	L1	CO5
	II : PART - B	**90**		
	UNIT - I	**18**		
2 a.	Define the following with an example: i) Alphabet ii) String iii) Kleen closure iv) Language	9	L1	CO1
b.	Write a regular expression corresponding to each of the following subsets of $(a, b)^*$ i) The language of all strings in which the numbers of a's is odd ii) The language of all strings that do not ends with ab iii) The language of all strings whose second symbol from the right end is a iv) $L=\{a^n b^m \mid n \geq 4, m \leq 3\}$	9	L3	CO1
c.	Design the DFA for the following language over $\Sigma = \{a, b\}$ i) $L = \{a W a \mid W \varepsilon (a, b)^*\}$ ii) Ending with ab or ba iii) Having even number of a's and odd numbers of b's	9	L3	CO1

UNIT - II 18

3 a. Convert the following NFA show in Fig.2.a to its equivalent DFA. — 9 L3 CO2

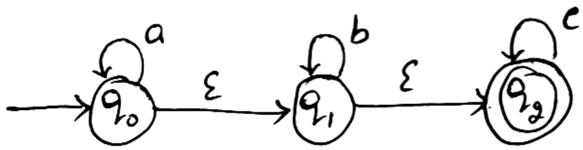

Fig.2.a

b. Prove that every R.E, There exists a FA which accepts the same language accepted by the R.E. — 9 L2 CO2

c. Obtain a R.E for the FA shown in Fig .2(c), using Kleen's theorem. — 9 L3 CO2

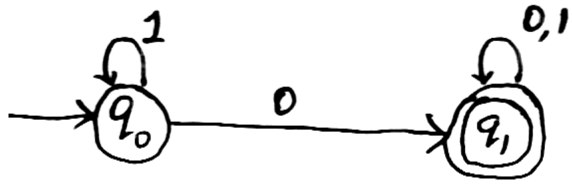

Fig.2(c)

UNIT - III 18

4 a. Construct a grammar for language representing strings of a's and b's — 4 L3 CO3

i) Having a substring ab

ii) $L = \{WW^R \mid W \varepsilon (a+b)^*\}$

iii) $L = \{ a^n b^{2n} \mid n, m \geq 1 \}$

iv) $L=\{ a^{m+n} b^m c^n \mid n, m \geq 1 \}$

b. i) Consider the CFG with the following productions: — 5 L3 CO3

E → E*T/T

T → F-T/F

F → (E)| a | b

Write the leftmost derivation and rightmost derivation for the string 'a-((b*a)-a)'

ii) Show that the given grammar is ambiguous

S → aB|bA

A → aS|bAA|a

B → bs|aBB|b

c. Convert the following CFG to CNF — 9 L3 CO3

S → ASB|ε

A → aAS|a

B → SbS|A|bb

	UNIT - IV	**18**		
5 a.	Construct a PDA to accept the language $L = \{WCW^R \mid W \varepsilon (a+b)^*\}$ where W^R is reverse of W by a final state.	9	L3	CO4
b.	Construct a PDA to accept a string of balanced parentheses. The parentheses to be considered are (,),[,].check whether the string [( )( )([ ])] is accepted or rejected.	9	L3	CO4
c.	Is the PDA to accept the language $L = \{W \mid W \varepsilon (a, b)^* \text{ and } n_a(W) > n_b(W)\}$ is deterministic?	9	L3	CO4
	UNIT - V	**18**		
6 a.	i) Describe a Turing machine model.	4	L2	CO5
	ii) Construct a TM to accept the language $L = \{\omega \mid \omega \varepsilon (0+1)^*\}$ containing the substring 001.	5	L3	
b.	Draw a T.M to accept the language $L = \{0^n 1^n \mid n \geq 1\}$.	9	L3	CO5
c.	Explain how to combine more than one TM with an example.	9	L2	CO5

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