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16CS/IS52

Fifth Semester B.E. Makeup Examination, January 2020

FORMAL LANGUAGES AND AUTOMATA THEORY

Time: 3 Hours

Max. Marks: 100

Instructions: 1. *Answer ANY FIVE full questions from Each UNIT*
2. *Assume any missing data*

UNIT - I

L CO PO M

1 a. What is Automata? With Neat schematic representation explain the working of Automata?

(01) (01) (01) (08)

b. Construct DFA for the following Languages

i. Set of all strings over $\Sigma=\{0,1\}$ starting with substring 01
ii. Set of all strings over $\Sigma=\{0,1\}$ ending with substring 011
iii. $L=\{\ |w| \bmod 3 <> 0,$ where $w \in \Sigma^*$ for $\Sigma=\{a, b\}\ \}$
iv. $L=\{\ |w| \bmod 3 \geq |w| \bmod 2,$ where $w \in \Sigma^*$ for $\Sigma=\{a, b\}\ \}$

(03) (01) (03) (12)

OR

2 a. Define Ɛ-NFA and Construct the Ɛ-NFA with four states for the following Language and Compute $\delta^*(q0, aabba)$

$L=\{a^n \mid n>=0\} \cup \{b^n a \mid n>=1\}$

(03) (01) (02) (08)

b. Apply Subset Construction Scheme by lazy evaluation and Convert the following Ɛ-NFA into an equivalent DFA

δ	Ɛ	a	b	c
$\rightarrow p$	Φ	{p}	{q}	{r}
q	{p}	{q}	{r}	Φ
*r	{q}	{r}	Φ	{p}

(03) (01) (12) (12)

UNIT – II

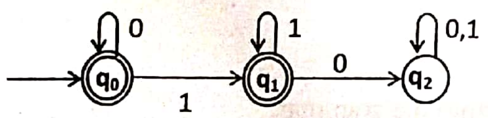
L CO PO M

3 a. Define Regular expression and build the Regular expression for the following languages

i. To accept a language consisting of strings of a's and b's of odd length.
ii. To accept a language consisting of strings of 0's and 1's that do not end with 01.
iii. $L=\{vwuv \mid u, v \in \Sigma^*$ for $\Sigma=\{a, b\}$ and $|v|=2\}$
iv. $L=\{\ |w| \bmod 3 = |w| \bmod 2,$ where $w \in \Sigma^*$ for $\Sigma=\{a, b\}\ \}$

(03) (02) (03) (10)

b. Apply State elimination method to identify the Regular Expression for the following finite Automata



(03) (02) (02) (10)

OR

4 a. State and prove the Pumping Lemma for Regular Languages. Apply Pumping Lemma and discover that the following language is Non-Regular

$L=\{0^n \mid n \text{ is perfect Square}\}$

(03) (03) (12) (10)

Note: L (Level), CO (Course Outcome), PO (Programme Outcome), M (Marks)

b. Apply Table Filling Algorithm and Determine the Minimum State Deterministic Finite Automata(DFA) for the following DFA shown in the Fig 4

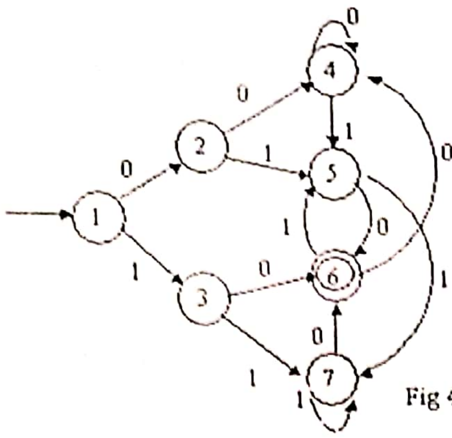


Fig 4

(05) (03) (03) (10)

L CO PO M

UNIT – III

5 a. Obtain a context free grammar to generate a language consisting of equal number of a's and b's. (2) (3) (1) (05)

b. Consider the context free grammar with productions.

E→I E→E+E

E→E*E E→(E)

I→a I→b

I→Ia I→Ib

I→I0 I→I1

Write leftmost derivation and parse tree for the string (a101+b1)*(a1+b). (4) (3) (1) (1

c. Eliminate Useless symbols in the grammar.

S → aA | bB

A → aA | a

B → bB

D → ab | Ea

E → aC | d

(2) (3) (1) (

OR

6 a. Show that the following grammar is ambiguous.

S→ aB|bA

A→ aS|bAA|a

B→ bS|aBB|b

(2) (3) (1) (08)

b. Eliminate Useless symbols in the grammar.

S → aA| a |Bb | cC

A → aB

(2) (3) (1) (04)

c. Eliminate all ϵ-productions from the grammar.

S→ ABCa|bD

A→ BC|b

B→ b| ϵ

C→c | ϵ

D→ d

(2) (3) (1) (08)

Note: L (Level), CO (Course Outcome), PO (Programme Outcome), M (Marks)

			L	CO	PO	M

UNIT – IV

7 a. Define Push Down Automata- PDA and Construct PDA for the following language by final state. Draw Transition Diagram and write the sequence of Instantaneous Description – ID's to trace the input string for n = 2.

$$L = \{a^n b^{2n} \mid a, b \in \Sigma, n \geq 0\}$$

(03) (04) (03) (10)

b. Define language acceptance of PDA and Construct PDA by empty stack for the following Grammar and write the sequence of Instantaneous Description – ID's to trace the input string – w = aaaaaa

$$S \rightarrow aAS \mid bAB \mid aB$$
$$A \rightarrow bBB \mid aS \mid a$$
$$B \rightarrow bA \mid a$$

(03) (04) (03) (10)

OR

8 a. Define Turing machine and With neat schematic diagram explain the working of Basic Turing machine.

(02) (04) (02) (10)

b. Construct Turing Machine to accept the following language and write the sequence of Instantaneous Description – ID's to trace the input string w = " aabb"

$$L = \{a^n b^n \mid a, b \in \Sigma, n \geq 0\}$$

(03) (04) (03) (10)

UNIT -V

L CO PO M

9 a. Explain the structure of LEX specification format with suitable example

(02) (05) (01) (10)

b. Develop a LEX program to count the number of identifiers, integer and floating point constants present in the input stream..

(03) (05) (03) (10)

OR

10 a. Explain the structure of YACC specification format with suitable example

(02) (05) (01) (10)

b. Develop a YACC program to recognize and evaluate the arithmetic expression involving additive operators (+, -) and multiplicative operators (*, /).

(03) (05) (03) (10)

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16CS/IS52/15IS52

Fifth Semester B.E. Semester End Examination, Dec./Jan. 2019-20

FORMAL LANGUAGES AND AUTOMATA THEORY

Time: 3 Hours — Max. Marks: 100

Instructions: 1. Answer any one full question from each UNIT.
2. Each full question of a UNIT carries 20 marks

UNIT - I

			L	CO	PO	M
1	a.	Define the following with an example for each. (i). Alphabet (ii). Strings (iii).Power of an alphabet (iv).Transition table (v). Transition diagram	(1)	(1)	(1)	(05)
	b.	Design a DFA to accept the language L={ w | w is of even length and begins with 01}.	(3)	(1)	(3)	(07)
	c.	Design a NFA which accepts strings of 0'and 1's that have the symbol 1 in the second last position. Convert NFA to equivalent DFA.	(3)	(1)	(3)	(08)
		OR				
2	a.	Design a NFA to accept strings of 0's and 1's that have 1 in third last position. Define Epsilon closures with an example.	(3)	(1)	(3)	(07)
	b.	Design a ε-NFA to accept the decimal number consisting of an optional+ or – sign, a string of digits, a decimal point and another string of digits, either this string of digits or string after decimal point can be empty but atleast one of the two strings is nonempty.	(6)	(1)	(3)	(08)
	c.	Design a DFA to accept the language L={awa | w Є (a+b)*}	(3)	(1)	(3)	(05)

UNIT – II

			L	CO	PO	M
3	a.	Prove that, If L=L(A) for some DFA A, then there is a regular expression R such that L=L(R).	(3)	(2)	(1)	(06)
	b.	Convert regular expression (0+1)*1(0+1) to a ε-NFA.	(3)	(2)	(1)	(06)
	c.	Design a NFA which accepts all strings containing 110. Convert it to a regular expression.	(3)	(2)	(1)	(08)
		OR				
4	a.	Minimize the following DFA using table filling algorithm.	(6)	(2)	(1)	(10)
	b.	Show that $L=\{a^nb^n \mid n\geq 0\}$ is not regular.	(3)	(2)	(1)	(05)

Table for 4 a.:

δ	0	1
→A	B	F
B	G	C
*C	A	C
D	C	G
E	H	F
F	C	G
G	G	E
H	G	C

Note: L (Level),CO (Course Outcome), PO (Programme Outcome), M (Marks)

c. State and Prove Pumping Lemma for regular languages. (3) (2) (1) (05)

L	CO	PO	M

UNIT - III

5 a. Define Context Free Grammar and Construct Context Free Grammar for the following Languages

i. Set of strings of a's and b's starting with substring 'ab'

ii. $L = \{ a^n b^m c^k \mid n = m + k, \text{ for } k, m >= 0\}$

(03) (02) (02) (06)

b. The following grammar generates the language of RE - 0*1(0+1)*

$S \rightarrow A \mid B$

$A \rightarrow 0A \mid \varepsilon$

$B \rightarrow 0B \mid 1B \mid \varepsilon$

Determine leftmost, rightmost derivations and Parse Tree for the following strings

a) 00101 b) 1001

(03) (02) (02) (10)

c. Prove that the family of Context free Languages is under UNION.

(05) (03) (12) (04)

OR

6 a. Define Ambiguous Grammar and Prove that the following grammar is ambiguous for string aab

$S \rightarrow aS \mid aSbS \mid \varepsilon$

(05) (02) (12) (06)

b. Simplify the following grammar by removing redundancies.

$S \rightarrow ASB \mid \varepsilon$

$A \rightarrow aAS \mid a$

$B \rightarrow SbS \mid A \mid bb$

(04) (03) (02) (10)

c. Organize the following grammar into an equivalent Grammar in Chomsky Normal Form – CNF

$S \rightarrow Aba \mid AB$

$A \rightarrow aab$

$B \rightarrow b$

(03) (03) (03) (04)

UNIT - IV

L	CO	PO	M

7 a. Design a turing machine to accept the language $L=\{0^n 1^n \mid n>=1\}$.

(6) (4) (1) (10)

b. Show that the PDA to accept the language L(M) = {w | w ε (a+b)* having equal number of a's and b's } is nondeterministic.

(2) (4) (1) (08)

c. Define deterministic PDA.

(1) (4) (1) (02)

OR

8 a. Design a turing machine to accept the language consisting of all palindromes of 0's and 1's.

(6) (4) (1) (10)

b. Design a PDA to accept the language $L(M) = \{wCw^R \mid w \in (a+b)^*$ where w^R is reverse of w$\}$ by a final state.

(6) (4) (1) (10)

UNIT -V

L	CO	PO	M

9 a. Explain the structure of lex program with an example.

(2) (5) (3) (07)

b. Write a word counting lex program.

(3) (5) (3) (07)

c. Explain yacc parser with an example.

(2) (5) (1) (06)

Note: L (Level),CO (Course Outcome), PO (Programme Outcome), M (Marks)

OR

10 a. Explain shift reduce parsing. (2) (5) (1) (07)

b. What is regular expression? Explain characters that form a regular expression. (2) (5) (1) (08)

c. Write lex specification for decimal numbers. (3) (5) (1) (05)

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15CS52/16CS/IS52

Fifth Semester B.E. Makeup Examination, January 2019

FORMAL LANGUAGES AND AUTOMATA THEORY

Time: 3 Hours | Max. Marks: 100

Instructions: 1. *UNIT III & V are Compulsory.*
2. *Answer any one full question from remaining each UNITS.*

UNIT - I

			L	CO	PO	M
1	a.	Rephrase the formal definition of DFA.	(1)	(1)	(2)	(04)
	b.	Design a DFA to accept the language L= {w|w is of the form x01y for some strings x and y consisting of 0's and 1's. **Compute $\hat{\delta}$*(q0, 00001111)**	(3)	(1)	(2)	(06)
	c.	Design an NFA which accepts exactly those strings that have the symbol 1 in the second last position. Convert NFA to equivalent DFA using Subset Construction scheme by lazy evaluation.	(4)	(1)	(2)	(10)

OR

			L	CO	PO	M
2	a.	Design a DFA to accept strings of a's and b's except those containing the substring aab	(3)	(1)	(2)	(06)
	b.	Design a ε-NFA to accept the decimal number consisting of an optional + or – sign, a string of digits, a decimal point and another string of digits, either this string of digits or string after decimal point can be empty but atleast one of the two strings is nonempty.	(4)	(1)	(2)	(08)
	c.	Design a DFA to accept the language L={awa | w Є (a+b)*}	(4)	(1)	(2)	(06)

UNIT – II

			L	CO	PO	M
3	a.	Define regular expression. Find regular expression for the following: i) L = { $a^n b^m$ | (m+n) is even } ii) Strings of a's and b's whose 4^{th} symbol from the end is 'b'. iii) Strings of 0's and 1's having no two consecutive zeros.	(3)	(2)	(2)	(07)
	b.	Show that the language L={ a^n | n is prime } is not regular.	(3)	(3)	(1)	(05)
	c.	Translate the following DFA to a regular expression using state-elimination method.	(2)	(2)	(1)	(08)

δ	0	1
-->*q_0	q_1	q_2
q_1	q_3	q_0
q_2	q_0	q_3
q_3	q_3	q_3

OR

			L	CO	PO	M
4	a.	State and prove pumping lemma for regular languages.	(3)	(3)	(1)	(06)

Note: L (Level), CO (Course Outcome), PO (Programme Outcome), M (Marks)

b. Minimize the following DFA using table-filling algorithm.

δ	0	1
-->A	B	F
B	G	C
*C	A	C
D	C	G
E	H	F
F	C	G
G	G	E
H	G	C

(3) (2) (3) (10)

c. Prove that if L and M are regular languages, then so is L∩M. (3) (3) (1) (04)

L CO PO M

UNIT - III

5 a. Define Context Free Grammar. Obtain a context free grammar to generate the following language.
$L=\{ a^{n-3} b^n \mid n\geq 3 \}$
(3) (3) (2) (06)

b. Consider the context free grammar with productions.

$E \rightarrow I$ $\quad$ $E \rightarrow E+E$
$E \rightarrow E*E$ $\quad$ $E \rightarrow (E)$
$I \rightarrow a$ $\quad$ $I \rightarrow b$
$I \rightarrow Ia$ $\quad$ $I \rightarrow Ib$
$I \rightarrow I0$ $\quad$ $I \rightarrow I1$

Write leftmost derivation and parse tree for the string (a101+b1)*(a1+b).
(4) (3) (2) (07)

c. **Define Useless variables and Eliminate Useless variables from the following grammar.**

$S \rightarrow aA \mid bB$
$A \rightarrow aA \mid a$
$B \rightarrow bB$
$D \rightarrow ab \mid Ea$
$E \rightarrow aC \mid d$

(2) (3) (2) (07)

UNIT - IV

L CO PO M

6 a. Define PDA. Describe the language accepted by PDA.
(2) (4) (12 (05)

b. Design a PDA for the language $L=\{ a^{2n} b^n \mid n>=1 \}$. Draw the transition diagram and also write the sequence of ID's for the string for n=3
(3) (4) (3) (10)

c. Define Turing machine. Explain with a neat diagram, the working of a basic Turing machine.
(2) (4) (12 (05)

OR

7 a. Explain the working of PDA with a diagram.
(2) (4) (12 (06)

b. Design a Turing machine to accept the following language
$L= L=\{ a^n b^n c^n \mid n >=1 \}$.
Also indicate the moves made by turing machine for the string n=2.
(3) (4) (3) (14)

UNIT -V

L CO PO M

8 a. Explain the structure of Lex program with an example.
(2) (5) (3) (10)

Note: L (Level), CO (Course Outcome), PO (Programme Outcome), M (Marks)

b. Write a word counting Lex program. (2) (5) (3) (05)

c. Explain shift reduce parsing. (2) (5) (12 (05)

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Fifth Semester B.E. Semester End Examination, Dec/Jan 2018-19

FORMAL LANGUAGES AND AUTOMATA THEORY

Time: 3 Hours **Max. Marks: 100**

Instructions: 1. UNIT-III and UNIT-V are compulsory
2. Answer any one full question from remaining units

UNIT - I

L CO PO M

1 a. Define the following with examples.
i) Alphabet ii) String iii) Language
(1) (1) (12) (6)

b. Design DFA for the following:
i) To accept the strings of a's and b's ending with 'abb'.
ii) L={ w such that |w| mod 4=0, w ∈ {a,b}* }
(3) (1) (3) (7)

c. Convert the following ε-NFA to DFA

δ	ε	a	b
-->p	{r}	{q}	{p, r}
q	Φ	{p}	Φ
*r	{p, q}	{r}	{p}

(3) (1) (3) (7)

OR

2 a. Define finite automata. List the applications of finite automata.
(1) (1) (12) (5)

b. Design a DFA to accept the binary numbers which are divisible by 4.
(3) (1) (3) (5)

c. Design an NFA to accept the strings of 0's and 1's whose 2nd symbol from the right end is '1'. Convert the same NFA to DFA.
(3) (1) (3) (10)

UNIT – II

L CO PO M

3 a. State and Prove Pumping Lemma for regular languages.
(2) (2) (3) (6)

b. Convert regular expression (0+1)*1(0+1) to a ε-NFA.
(2) (2) (3) (6)

c. Design a NFA which accepts all strings containing 110. Convert it to a regular expression using state elimination method.
(4) (2) (3) (8)

OR

L CO PO M

4 a. Show that $L=\{a^nb^n \mid n\geq 0\}$ is not regular.
(3) (2) (2) (5)

Note: L (Level), CO (Course Outcome), PO (Programme Outcome), M (Marks)

b. Minimize the following DFA using table filling algorithm.

δ	0	1
→A	B	F
B	G	C
*C	A	C
D	C	G
E	H	F
F	C	G
G	G	E
H	G	C

(3) (2) (2) (10)

c. Prove that If L is a regular language over an alphabet Σ then $\bar{L} = \Sigma^* - L$ is also a regular language.

(5) (2) (2) (5)

L CO PO M

UNIT - III

5 a. Define context-free-grammar(CFG). Construct CFG for the following languages:
i) L= { w | w ε (0+1)*110 }
ii) L= { $0^{n+1}1^n$ | n >=1 }

(3) (2) (2) (6)

b. Write the LMD, RMD and parse tree for the string '+*-xyxy' using the grammar
E --> +EE | *EE | -EE | x | y

(3) (2) (2) (6)

c. Convert the following grammar into CNF.
S --> 0A | 1B
A--> 0AA | 1S | 1
B --> 1BB | 0S | 0

(3) (3) (3) (8)

L CO PO M

UNIT - IV

6 a. Define Push Down Automata.

(1) (4) (2) (3)

b. Design a PDA to accept the language L(M)= {wCw^R | w ε (a+b)* where w^R is reverse of w by a final state.

(3) (4) (2) (8)

c. Show that the PDA to accept the language L(M) = {w | w ε (a,b)* and $n_a(w) > n_b(w)$ } is nondeterministic.

(3) (4) (2) (9)

L CO PO M

OR

7 a. Explain the Programming techniques for Turing machines.

(2) (4) (2) (8)

b. Define Turing machine.

(1) (4) (3) (2)

c. Design a Turing machine to accept the language consisting of all palindromes of 0's and 1's.

(3) (4) (2) (10)

L CO PO M

UNIT -V

8 a. Explain the structure of Lex with an example.

(2) (5) (12) (6)

b. Explain parser-lexer communication.

(2) (5) (12) (6)

c. Write a yacc program to recognize an arithmetic expression involving operators +, -, * and /.

(3) (5) (3) (8)

Note: L (Level), CO (Course Outcome), PO (Programme Outcome), M (Marks)