USN	0	1	J	C	E	2	1	C	S	1	2	1

"20CS450"

JSS MAHAVIDYAPEETHA

JSS SCIENCE AND TECHNOLOGY UNIVERSITY, MYSURU.

Department of Computer Science and Engineering.

IV Semester C Section: Test-1

THEORY OF COMPUTATION

Duration : 1Hrs Date: 06.05.2023 Max. Marks:20

NOTE: Answer all the questions

Q.NO	CO	CD	PI	QUESTION	MARKS
1.a	CO1	L3	1.7.1	Define Deterministic finite automata (DFA). Design DFA to accepts set of string either start with 01 or ends with 01 over the alphabet {0,1}.	06
1.b	CO1	L3	1.7.1	Write subset construction algorithm with an example	04
2.a	CO1	L3	1.7.1	Convert the following automata to DFA. (table below)	06
2.b	CO1	L1	1.6.1	Define the following: a) Automata with output and without output. b) Difference between DFA and NFA	04
				OR	
3.a	CO1	L1	1.6.1	Write the formal definition for the following terms with an example a) Alphabet. b) Language. c) Symbol.	04
3.b	CO1	L3	1.7.1	Define NFA. Consider the following NFA (table below) i) Convert the automation to a DFA.	06

Table for 2.a:

δ	0	1
→ p	{q, s}	{q}
*q	{r}	{q, r}
r	{s}	{p}
*s	Φ	{p}

Table for 3.b:

δ	ϵ	a	b
→ P	{R}	{Q}	{P, R}
Q	Φ	{P}	Φ
R	{P, Q}	{R}	{P}
*S	{P}	{P}	{P}

USN	0	1	J	C	E	2	1	C	S	1	2	1

"20CS450"

JSS MAHAVIDYAPEETHA

JSS SCIENCE AND TECHNOLOGY UNIVERSITY, MYSURU.

Department of Computer Science and Engineering.

IV Semester: Test-III

THEORY OF COMPUTATION

Duration: 1Hrs Date: 08.07.2023 Max. Marks:20

NOTE: Answer all the questions

Q.NO	CO	CD	PI	QUESTION	MARKS
1.a	CO4	L3	1.7.1	Design Pushdown automata for the following languages. i) $L = \{ a^n b^n : n \geq 0\}$ ii) $L = \{WCW^R : W \in \{a, b\}^*$	06
1.b	CO4	L1	1.6.1	Define the following terms i) Deterministic Pushdown automata ii) Language of PDA	04
2.	CO3	L3	1.7.1	Define useless production and Simplify the following grammar $S \rightarrow aA \mid aBB$ $A \rightarrow aaA \mid \epsilon$ $B \rightarrow bB \mid bbC$ $C \rightarrow B$	10
OR					
3.	CO3	L3	1.7.1	Define Chomsky normal form(CNF) and convert the following grammar to CNF $S \rightarrow AAA \mid B$ $A \rightarrow aA \mid B$ $B \rightarrow \epsilon$	10

Course Outcome: At the end of the course the students will have the ability to	
CO–1	Design automata for given regular languages.
CO–2	Define Regular expression and check its equivalence among automata.
CO–3	Write grammar for context free languages and parse the given input.
CO–4	Design pushdown Automata and show the equivalence of CFG and PDA
CO–5	Apply the techniques of Turing machine, decidability and intractability of Computational problems.

PI's	
1.6.1.	Apply engineering fundamentals
1.7.1	Apply theory and principles of computer science and engineering to solve an engineering problem

Levels	Cognitive Domain
L1	Remembering
L2	Understanding

USN	0	1	J	C	E	2	1	C	S	1	2	1

"20CS450"

JSS MAHAVIDYAPEETHA

JSS SCIENCE AND TECHNOLOGY UNIVERSITY, MYSURU.

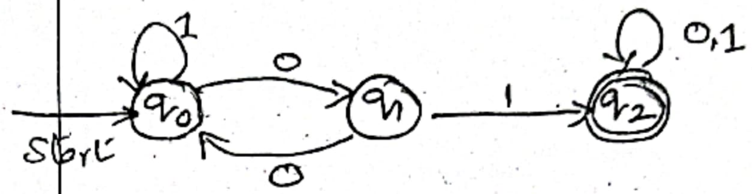
Department of Computer Science and Engineering.

IV Semester : Test-2

THEORY OF COMPUTATION

Duration : 1Hrs Date: 14.06.2023 Max. Marks:20

NOTE: Answer all the questions

Q.NO	CO	CD	PI	QUESTION	MARKS
1.a	CO2	L3	1.7.1	Write regular expression for the following [(0+1)1(0+1)]* i) Set of string 0's and 1's having no two consecutive zeros ii) Set of strings of 0's and 1's whose lengths are multiples of 3.	06
1.b	CO2	L3	1.7.1	Obtain the regular expression for the following DFA using state elimination method. 	04
2.a	CO3	L3	1.7.1	Design Context free grammar for the following languages. i) $L = \{ a^n b^n : n > 0\}$ ii) $L = \{ ab(bbaa)^n bba(ba)^n : n >= 0\}$	06
2.b	CO3	L1	1.6.1	Write formal definition for the following i) Regular expression. ii) Context free grammar.	04
				OR	
3.a	CO3	L3	1.7.1	Consider the grammar $E \rightarrow +EE \mid *EE \mid -EE \mid x \mid y$ Find the leftmost and rightmost derivation for the input string +*-xyxy and write derivation tree.	06
3.b	CO3	L3	1.7.1	Define Ambiguous grammar. Show that the following grammar is ambiguous $S \rightarrow AB \mid aaB$ $A \rightarrow a \mid Aa$ $B \rightarrow b$	04

Course Outcome: At the end of the course the students will have the ability to	
CO–1	Design automata for given regular languages.
CO–2	Define Regular expression, and check its equivalence among automata.
CO–3	Write grammars for context free languages and parse the given input.
CO–4	Design pushdown Automata and show the equivalence of CFG and PDA
CO–5	Apply the techniques of Turing machine, decidability and intractability of Computational problems.

PI's	
1.6.1.	Apply engineering fundamentals
1.7.1	Apply theory and principles of computer science and engineering to solve an engineering problem

Levels	Cognitive Domain
L1	Remembering
L2	Understanding
L3	Applying

JSS MAHAVIDYAPEETHA

JSS SCIENCE AND TECHNOLOGY UNIVERSITY, MYSURU

IV Semester BE Degree Examination
Department of Computer Science and Engineering
THEORY OF COMPUTATION

Duration: 3 Hrs   Max. Marks:100

<u>NOTE</u>: **Answer all the questions. Part- B has internal choice.**

PART – A

Q.NO	CO	CD	PI	QUESTION	MARKS
1.	CO5	Applying	2.3.1	Define deterministic finite automata. Design DFA to accept the set of string having even number of a's and odd number of b's. Compute the extended transition function for input string "ababb".	10
2.a	CO3	Applying	1.4.1	Define regular expression. Write regular expression for the set of string of 0's and 1's having no two consecutive zeros.	04
2.b	CO4	Analyzing	1.4.1	Prove that every language defined by regular expression is also defined by finite automata.	06
3.	CO3	Applying	1.4.1	Write context free grammar for the following languages $L = \{ a^i b^j c^k : i + j = k , i \geq 0, j \geq 0 \}$ Also write left most, right most derivation and derivation tree for the input string "aabbcccc".	10
4.	CO5	Applying	2.3.1	Construct a pushdown automata that accepts the following language $L = \{ w : w \in \{a, b\}^* \text{ and } n_a(w) = n_b(w)\}$ Write the instantaneous description for the input string "aababb".	10
5.	CO5	Applying	2.3.1	Construct Turing machine to accept the even length of palindrome over $\{a, b\}^*$, also write its transition diagram and give instantaneous description for the input "abba".	10

<u>PART – B</u>

<table>
<tr><th>Q.NO</th><th>CO</th><th>CD</th><th>PI</th><th>QUESTION</th><th>MARKS</th></tr>
<tr><td>6.a</td><td>CO1</td><td>Remember</td><td>1.4.1</td><td>Define the following term with an example.
i) Alphabet ii) Nondeterministic finite automata
iii) Epsilon Closure</td><td>04</td></tr>
<tr><td>6.b</td><td>CO2</td><td>Applying</td><td>1.4.1</td><td>Convert the following finite automata into DFA.
<table>
<tr><td>δ</td><td>ε</td><td>0</td><td>1</td></tr>
<tr><td>A</td><td>{ B, D}</td><td>{ A }</td><td>∅</td></tr>
<tr><td>B</td><td>∅</td><td>{ C }</td><td>{ E }</td></tr>
<tr><td>C</td><td>∅</td><td>∅</td><td>{ B }</td></tr>
<tr><td>D</td><td>∅</td><td>{ E }</td><td>{ D }</td></tr>
<tr><td>*E</td><td>∅</td><td>∅</td><td>∅</td></tr>
</table></td><td>06</td></tr>
<tr><td colspan="6" align="center">OR</td></tr>
<tr><td>7.a</td><td>CO2</td><td>Applying</td><td>1.4.1</td><td>Convert the following NFA into DFA.
<table>
<tr><td>δ</td><td>0</td><td>1</td></tr>
<tr><td>→q_0</td><td>{ q_0 , q_1 }</td><td>{ q_0 }</td></tr>
<tr><td>q_1</td><td>∅</td><td>{ q_2 }</td></tr>
<tr><td>*q_2</td><td>∅</td><td>∅</td></tr>
</table></td><td>04</td></tr>
<tr><td>7.b</td><td>CO2</td><td>Applying</td><td>1.4.1</td><td>Minimize following DFA by using table filling algorithm.
<table>
<tr><td>δ</td><td>0</td><td>1</td></tr>
<tr><td>→A</td><td>B</td><td>C</td></tr>
<tr><td>B</td><td>D</td><td>E</td></tr>
<tr><td>C</td><td>F</td><td>G</td></tr>
<tr><td>D</td><td>D</td><td>E</td></tr>
<tr><td>E</td><td>F</td><td>G</td></tr>
<tr><td>*F</td><td>D</td><td>E</td></tr>
<tr><td>G</td><td>F</td><td>G</td></tr>
</table></td><td>06</td></tr>
</table>

<table>
<tr><td>8</td><td>CO4</td><td>Analyzing</td><td>1.4.1</td><td>State and prove the pumping lemma for regular languages. Show that $L=\{ a^nb^n : n\geq 0 \}$ is not regular.</td><td>10</td></tr>
<tr><td colspan="6">OR</td></tr>
<tr><td>9.a</td><td>CO3</td><td>Applying</td><td>1.4.1</td><td>Obtain the regular expression for the following DFA using state elimination technique.
<table>
<tr><td>δ</td><td>0</td><td>1</td></tr>
<tr><td>$\rightarrow q_0$</td><td>q_1</td><td>q_0</td></tr>
<tr><td>q_1</td><td>q_1</td><td>q_2</td></tr>
<tr><td>$*q_2$</td><td>q_1</td><td>q_0</td></tr>
</table></td><td>06</td></tr>
<tr><td>9.b</td><td>CO2</td><td>Applying</td><td>1.4.1</td><td>Convert the regular expression $(a + b^*)^*ba$ into ε-NFA.</td><td>04</td></tr>
</table>

10.a	CO3	Remember	1.4.1	Define ambiguous grammar. show that the following grammar is ambiguous. $S \rightarrow aS \mid aSbS \mid \varepsilon$	04
10.b	CO3	Understanding	1.4.1	Mention the application of context free grammar and explain any one in detail.	06
OR					
11.a	CO3	Applying	1.4.1	Define Chomsky normal form. Convert the following grammar to CNF. $S \rightarrow aSb \mid ab \mid Aa$ $A \rightarrow aab$	04
11.b	CO3	Applying	1.4.1	Eliminate all ε-production from the following grammar. $S \rightarrow aAa \mid AB$ $A \rightarrow BS \mid aBa \mid \varepsilon$ $B \rightarrow aB \mid \varepsilon$	06

12.a	CO1	Remembering	1.4.1	Define the following term i) Language of PDA. ii) Deterministic pushdown automata.	06

12.b	CO4	Applying	1.4.1	Construct a PDA for the following Grammar. $S \rightarrow 0S1 \mid A$ $A \rightarrow 0A1 \mid S \mid \varepsilon$	04
OR					
13	CO5	Applying	2.3.1	Design the deterministic pushdown automata for the following language $L = \{ a^n c^m b^n : n \geq 1, m \geq 2 \}$ And also show the instantaneous description for the input string " "	10

14	CO1	Understanding	1.4.1	Define Turing machine. With a neat diagram, explain the multitape Turing machine.	10
OR					
15	CO1	understanding	1.4.1	Write short notes on the following: i) Multi stack Turing machine. ii) Post correspondence problem.	10

Course Outcome: At the end of the course the students will have the ability to	
CO–1	Understand and explain the concepts of Automata Theory and formal Language.
CO–2	Apply the concepts of theoretical foundations of computing to show the equivalence among different notations of regular and context free languages.
CO–3	Analyze the given language and formulate regular expressions and context free grammars.
CO–4	Identify the class of languages based on Chomsky hierarchy to prove the membership of regular and context free languages.
CO–5	Design and implement automata for regular, context free, and recursively enumerable languages corresponding to real world problem.

Performance Indicator:

1.4.1	Apply theory and principles of computer science and engineering to solve an engineering problem
2.3.1	Able to apply computer engineering principles to formulate modules of a system with required applicability and performance.

--- End ---