P.S.R.ENGINEERING COLLEGE
(An Autonomous Institution, Affiliated to Anna University, Chennai) Sevalpatti (P.O), Sivakasi - 626140.

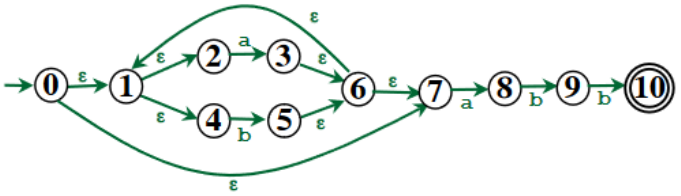
DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING

Department:	CSE	Programme:	B.E. Computer Science and Engineering
Academic Year:	2024-25	Year/Sem/Sec :	III / V / I&II
Course Code:	**191CS51**	Course Name:	**THEORY OF COMPUTATION**
Course Tutor:	Mrs.S.Sujitha AP/CSE		

UNIT 1

	PART A	**Marks**	**Bloom's Category Level**	**CO's**
1.	Which of the following is not a part of 5-tuple finite automata? a) Input alphabet b) Transition function c) Initial State d) Output Alphabet	1	K1	CO1
2.	The finite automata accept which of the following languages a) Context Free Languages b) Context Sensitive Languages c) Regular Languages d) All the mentioned	1	K1	CO1
3.	Which of the following options is correct? Statement 1: Initial State of NFA is Initial State of DFA. Statement 2: The final state of DFA will be every combination of final state of NFA. a) Statement 1 is true and Statement 2 is true b) Statement 1 is true and Statement 2 is false c) Statement 1 can be true and Statement 2 is true d) Statement 1 is false and Statement 2 is also false	1	K1	CO1
4.	Which of the following is not a part of 5-tuple finite automata? a) Input alphabet b) Transition function c) Initial State d) Output Alphabet	1	K1	CO1
5.	Finite automata requires minimum _____ number of stacks. a) 1 b) 0 c) 2 d) None of the mentioned	1	K1	CO1
6.	An automaton that presents output based on previous state or current input: a) Acceptor b) Classifier c) Transducer d) None of the mentioned.	1	K1	CO1

7.	NFA, in its name has 'non-deterministic' because of : a) The result is undetermined b) The choice of path is non-deterministic c) The state to be transited next is non-deterministic d) All of the mentioned	1	K1	CO1
8.	Given Language L= {xϵ {a, b}*|x contains aba as its substring} Find the difference of transitions made in constructing a DFA and an equivalent NFA? a) 2 b) 3 c) 4 d) Cannot be determined	1	K1	CO1
9.	e-transitions are a) conditional b) unconditional c) input dependent d) none of the mentioned	1	K1	CO1
10	The e-NFA recognizable languages are not closed under : a) Union b) Negation c) Kleene Closure d) None of the mentioned	1	K1	CO1
	PART B			
11.	Distinguish between DFA and NFA	2	K2	CO1
12.	Design a DFA that accepts strings ending with 00 over Σ={0,1}	2	K6	CO1
13.	Design a DFA that accepts atmost 3 a's	2	K6	CO1
14.	Define finite automata and transition diagram	2	K1	CO1
15.	Construct a RE for the language accepting all strings which are having even length of strings over the set Σ={1}	2	K3	CO1
16.	What is Computation? and Write short notes on TOC.	2	K1	CO1
17.	Define Automaton	2	K1	CO1
18.	Define Inductive and Deductive proof	2	K1	CO1
19.	Define hypothesis.	2	K1	CO1
20.	What is the principle of Mathematical Induction?	2	K1	CO1
21.	List any four ways of theorem proving.	2	K1	CO1
22.	What is structural Induction?	2	K1	CO1
23.	Write the central concepts of Automata Theory	2	K1	CO1
24.	Define Language and Give example.	2	K1	CO1
25.	Define transition diagram.	2	K1	CO1
	PART C			
26	Build DFA for the following Ɛ-NFA	14	K3	CO1

<table>
<tr><td></td><td> 
</td><td></td><td></td><td></td></tr>
<tr><td>27</td><td>Explain the different forms of proof with examples.</td><td>14</td><td>K2</td><td>CO1</td></tr>
<tr><td>28</td><td>Prove that, if L is accepted by an NFA with εtransitions, then L is accepted by an NFA without ε-transitions.</td><td>14</td><td>K5</td><td>CO1</td></tr>
<tr><td>29</td><td>Prove by induction on n that
i. $\sum_{i=0}^{n} i\hat{}2 = n(n+1)(2n+1)/6$
i. $\sum_{i=0}^{n} i\hat{}2 = n(n+1)(2n+1)/6$
ii. $\sum_{i=o}^{n} i = n(n+1)/2$ i. $\sum_{i=0}^{n} i\hat{}2 = n(n+1)(2n+1)/6$</td><td>14</td><td>K5</td><td>CO1</td></tr>
<tr><td>30</td><td>Determine whether the strings “ababba” , “ baab” are accepted by the DFA?
<table>
<tr><th>Input/states</th><th>a</th><th>b</th></tr>
<tr><td>□q0</td><td>q0</td><td>q1</td></tr>
<tr><td>*q1</td><td>q2</td><td>q1</td></tr>
<tr><td>q2</td><td>q1</td><td>q1</td></tr>
</table></td><td>14</td><td>K1</td><td>CO1</td></tr>
<tr><td>31</td><td>Develop the following NFA to DFA
<table>
<tr><td>Q/ Σ</td><td>0</td><td>1</td></tr>
<tr><td>->{p}</td><td>{q,s}</td><td>{q}</td></tr>
<tr><td>{q}</td><td>{r}</td><td>{q,r}</td></tr>
<tr><td>{r}</td><td>{s}</td><td>{p}</td></tr>
<tr><td>*{s}</td><td>φ</td><td>{p}</td></tr>
</table></td><td>14</td><td>K6</td><td>CO1</td></tr>
</table>

UNIT 2

	PART A	Marks	Bloom’s Category Level	CO’s
1.	While applying Pumping lemma over a language, we consider a string w that belong to L and fragment it into _____ parts. a) 2 b) 5 c) 3 d) 6	1	K1	CO2
2.	Concatenation Operation refers to which of the following set operations: a) Union b) Dot c) Kleene d) Two of the options are correct	1	K1	CO2

3.	Regular expression for all strings starts with *ab* and ends with *bba* is. a) *aba*b*bba* b) *ab(ab)*bba* c) *ab(a+b)*bba* d) All of the mentioned	1	K1	CO2
4.	The total number of states required to automate the given regular expression (00)*(11)* a)3 b)4 c)5 d) 6	1	K1	CO2
5.	. Generate a regular expression for the given language:l L(x): {xÎ{0,1}*| x ends with 1 nd does not contain a substring 01} a)(0+01)* b)(0+01)*1 c)(0+01)*(1+01) d) All of the mentioned	1	K1	CO2
6.	The minimum number of transitions to pass to reach the final state as per the following regular expression is: {a,b}*{baaa} a) 4 b) 5 c) 6 d) 3	1	K1	CO2
7.	What kind of expressions do we used for pattern matching? a) Regular Expression b) Rational Expression c) Regular & Rational Expression d) None of the mentioned	1	K1	CO2
8.	Which of the following do Regexps do not find their use in? a) search engines b) word processors c) sed d) none of the mentioned	1	K1	CO2
9.	The following is/are an approach to process a regexp: a) Construction of NFA and subsequently, a DFA b) Thompson's Contruction Algorithm c) Thompson's Contruction Algorithm & Construction of NFA	1	K1	CO2

	and subsequently, a DFA d) None of the mentioned			
10.	A language is regular if and only if a) accepted by DFA b) accepted by PDA c) accepted by LBA d) accepted by Turing machine	1	K1	CO2
	PART B			
11.	What the closure properties of Regular Languages	2	K1	CO2
12.	What is a regular expression ?	2	K1	CO2
13.	Construct a RE for the language accepting all strings which are having odd length of strings over the set Σ={0}	2	K6	CO2
14.	Define pumping lemma for regular sets.	2	K1	CO2
15.	Give a regular expression for the set of all strings having odd number of 1's	2	K1	CO2
16.	Give the regular expression for the set of all strings ending in 00.	2	K1	CO2
17.	What are the applications of regular expression?	2	K1	CO2
	PART C			
18.	<table><tr><td>input/states</td><td>0</td><td>1</td></tr><tr><td>□*q1</td><td>q1</td><td>q2</td></tr><tr><td>q2</td><td>q3</td><td>q2</td></tr><tr><td>q3</td><td>q1</td><td>q2</td></tr></table>Construct a regular expression for the following DFA	14	K6	CO2
19.	Explain in detail about pumping lemma for Regular Languages.	14	K2	CO2
20.	Prove that the language is not regular by using pumping lemma L={a^{i^2} | i>=1}	14	K5	CO2
21.	Give regular expressions for the following L1=set of all strings of 0 and 1 ending in 00 L2=set of all strings of 0 and 1 beginning with 0 and ending with 1.	14	K1	CO2
22.	Find the language generated by the grammar G={{S},{a,b},P,S} with productions, S->aSa | bSb | Ɛ	14	K1	CO2
23.	Construct NFA for the regular expression a*b*.	14	K6	CO2
24.	Is regular set is closed under complementation?Justify.	14	K1	CO2
25.	Prove by pumping lemma, that the language 0n1 n is not regular	14	K5	CO2

UNIT 3

	PART A			
1.	A->aA| a| b The number of steps to form aab: a) 2	1	CO3	K1

	b) 3 c) 4 d) 5			
2.	To derive a string using the production rules of a given grammar, we use: a) Scanning b) Parsing c) Derivation d) All of the mentioned	1	CO3	K3
3.	A push down automaton employs _____ data structure. a) Queue b) Linked List c) Hash Table d) Stack	1	CO3	K1
4.	Which of the production rule can be accepted by Chomsky grammar? a) A->BC b) A->a c) S->e d) All of the mentioned	1	CO3	K3
5.	What the does the given CFG defines? *S->aSbS|bSaS|e* and w denotes terminal a) ww^r b) *wSw* c) Equal number of *a's* and *b's* d) None of the mentioned	1	K1	CO3
6.	A string is accepted by a PDA when a) Stack is not empty b) Acceptance state c) All of the mentioned d) None of the mentioned	1	K1	CO3
7.	Suppose A->xBz and B->y, then the simplified grammar would be: a) A->xyz b) A->xBz|xyz c) A->xBz|B|y d) none of the mentioned	1	K1	CO3
8.	Inorder to simplify a context free grammar, we can skip the following operation: a) Removal of null production b) Removal of useless symbols c) Removal of unit productions d) None of the mentioned	1	K1	CO3
9.	In context to the process of removing useless symbols, which of the following is correct? a) We remove the Nullable variables b) We eliminate the unit productions c) We eliminate products which yield no terminals d) All of the mentione	1	K1	CO3
10	Which of the following allows stacked values to be sub-stacks rather than just finite symbols? a) Push Down Automaton b) Turing Machine	1	K1	CO3

	c) Nested Stack Automaton d) None of the mentioned			
	PART B			
11	When do you say an grammar is ambiguous?	2	K1	CO3
12	Analyze that CFL are closed under Union	2	K1	CO3
13	Find the grammar is ambiguious S -> SS | (S) | S(S)S | E	2	K1	CO3
14	What is mean by Greibach Normal Form?	2	K1	CO3
15	Compare NFA with PDA.	2	K2	CO3
16	What are the different types of language accepted by a PDA and define them?	2	K2	CO3
17	Specify the use of context free grammar.	2	K1	CO3
18	Define parse tree with an example.	2	K1	CO3
19	Show that CFL are closed under Concatenation.	2	K1	CO3
	PART C			
20	Develop the CFG, G= { { S,I},T,P,S} where T={+,*,(,),a,b,0,1} and P is given as S-> I| S+S | S*S | (S) , I->a | b | Ia | Ib | I1| I0 Derive a*(a+b00).	14	K3	CO3
21	Show that id + id * id can be generated by two distinct left most derivation in the grammar E -> E + E | E * E| (E) | id	14	K2	CO3
22	Find the GNF equivalent of the grammar S->AA|0, A-> SS|1	14	K1	CO3
23	Give the CFG for the PDA, M=({q0,q1}, {0,1},{z0,x}, δ ,q0,z0) δ (q0,1,z0) = (q0,xz0) δ (q0,1,x) = (q0,xx) δ (q0,0,x) = (q1,x) δ (q0, ϵ,z0) = (q0, ϵ) δ (q1,1,x) = (q1, ϵ) δ (q1,0,z0) = (q0,z0)	14	K1	CO3
24	Find Greibach normal form for the following grammar S→a|AB, A→a|BC, B→b, C→b	14	K1	CO3
25	Let G be the grammar S→aB|bA A→a|aS|bAA B→b|bS|aBB. For the string aaabbabbba, Find (a) LMD (b) RMD	14	K1	CO3
26	Find the context free languages for the following grammars. 1. S→aSbS|bSaS| ε	14	K1	CO3
27	Construct the PDA accepting the language 1. L={$(ab)^n$ |n>=1} by empty stack	14	K3	CO3

	2. L={$a^{2n}b^{n}$ |n>=1} Trace your PDA for the input with n=3. 3. L={ww^{R}|w is in (a+b)*} 4. L={$0^{n}1\ 2^{n}$} by empty stack 5. L={ww^{R}w|w is in {0+1}*}			

UNIT 4

	PART A			
	A turing machine with several tapes is known as: a) Multi-tape turing machine b) Poly-tape turing maching c) Universal turing machine d) All of the mentioned	1	K1	CO4
	Turing machine can be represented using the _____ tools a) Transition graph b) Transition table c) Queue and Input tape d) All of the mentioned	1	K1	CO4
	A turing machine operates over a) finite memory tape b) infinite memory tape c) depends on the algorithm d) none of the mentioned	1	K1	CO4
	Which of the following a turing machine does not consist of? a) input tape b) head c) state register d) none of the mentioned	1	K1	CO4
	The value of n if turing machine is defined using n-tuples: a) 6 b) 7 c) 8 d) 5	1	K1	CO4
	Which of the following are the models equivalent to Turing machine? a) Multi tape turing machine b) Multi track turing machine c) Register machine d) All of the mentioned	1	K1	CO4
	A _____ is a multi tape turing machine whose input tape is read only. a) Counter Machine b) Multi-stack c) Alternating Turing machine d) None of the mentioned	1	K1	CO4

	Instantaneous description of a counter machine can be described using: a) the input tape contents b) position of the input head c) distance of storage heads from symbol Z d) all of the mentioned	1	K1	CO4
	Which of the following parameters cannot be used to restrict a turing machine? a) tape alphabets b) number of tapes c) number of states d) none of the mentioned	1	K1	CO4
	A multi track turing machine can described as a 6-tuple (Q, X, S, d, q0, F) where X represents: a) input alphabet b) tape alphabet c) shift symbols d) none of the mentioned	1	K1	CO4
	PART B			
26	Define a Turing Machine.	2	K1	CO4
27	What are the applications of Turing Machine?	2	K1	CO4
28	Construct a Turing machine to compute 'n mod 2' where n is represented in the tape in unary form consisting of only 0's.	2	K3	CO4
29	Design a TM that accepts the language of odd integers written in binary.	2	K6	CO4
30	What are the required fields of an instantaneous description of a Turing machine?	2	K1	CO4
31	Compare Multitape and multihead Turing machine?	2	K2	CO4
	PART C			
1.	Design a Turing machine M to implement the function $\{a^n b^n \mid n>0\}$	14	K6	CO4
2.	Design a Turing machine to compute addition on two unary numbers.	14	K6	CO4
3.	Discuss the programming Techniques for Turing machine	14	K1	CO4
4.	Design a Turing machine for the following Reverses the given string {abb}.	14	K6	CO4
5.	Perform proper subtraction on two unary numbers.	14	K1	CO4
6.	What is a multitape turing machine?	14	K1	CO4
7.	Design a Turing machine M to implement the function $\{a^n b^n c^n \mid n>0\}$	14	K6	CO4

8.	Design a Turing machine to compute multiplication of two unary numbers.	14	K6	CO4

UNIT 5

	PART A			
1.	If the number of steps required to solve a problem is $O(n^k)$, then the problem is said to be solved in: a) non-polynomial time b) polynomial time c) infinite time d) none of the mentioned	1	K1	CO5
2.	The language accepted by a turing machine is called _____ a) Recursive Ennumerable b) Recursive c) Recursive Ennumerable and Recursive d) None	1	K1	CO6
3.	The decision problem is the function from string to _____ a) char b) int c) boolean d) none of the mentioned	1	K1	CO6
4.	Rec-DFA = { | M is a DFA and M recognizes input w}. Fill in the blank: Rec-DFA is _____ a) Undecidable b) Decidable c) Non finite d) None of the mentioned	1	K1	CO6
5.	Decidable can be taken as a synonym to: a) recursive b) non recursive c) recognizable d) none of the mentioned	1	K1	CO6
6.	An algorithm is called efficient if it runs in _____ time on a serial computer. a) polynomial b) non polynomial c) logarithmic d) none of the mentioned	1	K1	CO5

7.	Post Correspondence problem is a) decidable decision problem b) undecidable decision problem c) not a decision problem d) none of the mentioned	1	K1	CO6
8.	PCP stands for? a) Post Correspondence Problem b) Post Corresponding Problem c) Pre Correspondence problem d) None of the mentioned	1	K1	CO6
9.	The hardest of NP problems can be: a) NP-complete b) NP-hard c) P d) None of the mentioned	1	K1	CO5
10.	Travelling sales man problem belongs to which of the class? a) P b) NP c) Linear d) None of the mentioned	1	K1	CO5
	PART B			
11.	What is mean by recursively enumerable language?	2	K1	CO6
12.	Define the class P and NP Problem.	2	K1	CO5
13.	When we say a problem is decidable? Give an example of undecidable problem.	2	K1	CO6
14.	Mention the difference between P and NP problems.	2	K2	CO5
15.	How to prove that the Post Correspondence problem is Undecidable.	2	K1	CO6
16.	Define the class P and NP complete.	2	K1	CO5
17.	What is recursive language?	2	K1	CO6
	PART C			
18.	Show that L_1 and L_2 are recursive languages then L_1 U L_2 is also recursive.	14	K2	CO6
19.	Prove that L_{ne} is recursively enumerable.	14	K5	CO6
20.	Explain in detail Post Correspondence Problem.	14	K2	CO6
21.	Prove that for two recursive languages L1 and L2 their union and intersection is recursive.	14	K5	CO6
22.	Outline note on NP Problems.	14	K2	CO5
23.	Prove that the halting problem is undecidable.	14	K5	CO6