NARASIMHA REDDY ENGINEERING COLLEGE
(Autonomous)
Approved by AICTE, New Delhi & Affiliated to JNTUH, Hyderabad
Accredited by NAAC with A Grade, Accredited by NBA

COMPUTER SCIENCE AND ENGINEERING

QUESTION BANK

Course Title : Formal Languages and Automata Theory

Course Code : CS3101PC

Regulation : NR20

Course Objectives:

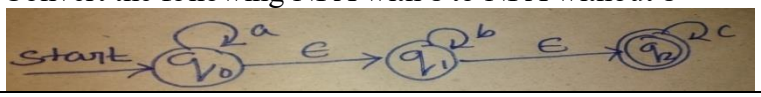
1. To provide introduction to some of the central ideas of theoretical computer science from the perspective of formal languages.
2. To introduce the fundamental concepts of formal languages, grammars and automata theory.
3. Classify machines by their power to recognize languages, grammars and automata theory.
4. Employ finite state machines to solve problems in computing.
5. To understand deterministic and non-deterministic machines.
6. To understand the differences between decidability and undecidability.

Course Outcomes (CO's):

1. To demonstrate abstract models of computing, to recognize the languages
2. To create Finite Automata's for different Regular Expressions and Languages
3. To construct context free grammar for various languages
4. To design turing machines
5. To understand grammars with the help of Chomsky Hierarchy and differentiate decidability, undecidability of problems.

UNIT–I
FINITE AUTOMATA

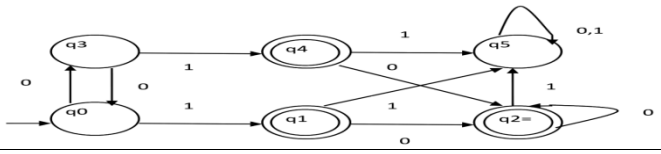
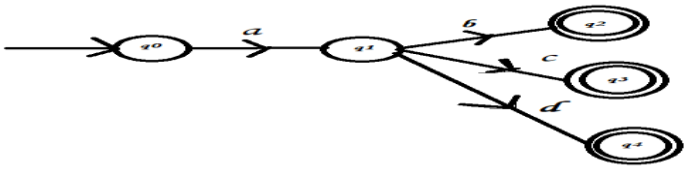
S.No	Questions	BT	CO	PO
Part – A (Short Answer Questions)				
1	Define Finite Automata.	L2	CO1	PO1
2	Explain structural representation of Finite Automata.	L4	CO1	PO1
3	Explain central concepts Automata Theory.	L1	CO1	PO2
4	Construct finite automata for a formal language over an alphabet {0,1} in which every string contains substring of "10" .	L1	CO1	PO2

5		Construct finite automata for a formal language over an alphabet {a,b} in which every string ends with "baba"	L1	CO1	PO1
6		What is Deterministic Finite Automata?	L4	CO1	PO1
7		What is NonDeterministic Finite Automata?	L1	CO1	PO1
8		Design NFA with {0,1} in which double '1' is followed by double '0'.	L5	CO1	PO1
9		Design NFA in which all the string contain a substring 1110.	L1	CO1	PO1
10		Write any four differences between DFA and NFA.	L3	CO1	PO2
Part – B (Long Answer Questions)					
11	a)	Convert the following NFA to DFA 	L1	CO1	PO1
	b)	Define Moore Machine. Explain with example.	L1	CO1	PO1
12	a)	Convert the following NFA with ε to NFA without ε 	L1	CO1	PO1
	b)	Obtain a DFA to accept strings of a's and b's having even number ofa's and b's.	L1	CO1	PO1
13	a)	Difference between Moore Machine and Mealy Machine.	L1	CO1	PO1
	b)	Construct a DFA to accept 0's and 1's in which string a) starts with '101' b) ends with '110'	L1	CO1	PO2
14	a)	Define Mealy Machine. Explain with example.	L1	CO1	PO1
	b)	Differentiate between DFA and NFA with Examples.	L2	CO1	PO1
15	a)	What is Finite Automata? Explain the structural representation of Finite Automata.	L3	CO1	PO2
	b)	Define NFA and DFA with example.	L1	CO1	PO2

UNIT–II

REGULAR LANGUAGES

S.No		Questions	BT	CO	PO
Part – A (Short Answer Questions)					
1		What is Regular Expression?	L4	CO2	PO2
2		What is the relation between Finite Automata and Regular expression?	L3	CO2	PO2
3		Explain the procedure to convert Finite automata to Regular Expression.	L3	CO2	PO2
4		What are the closure properties of Regular Languages?	L2	CO2	PO1
5		Write the steps to prove pumping lemma for Regular Languages	L4	CO2	PO1
6		What are the applications of Pumping Lemma?	L1	CO2	PO1
7		Write the steps to minimize the Automata.	L1	CO2	PO1
8		Show that L= { $a^n b^n$| n>=1} is not a regular language using pumpinglemma.	L1	CO2	PO2
Part – B (Long Answer Questions)					
11	a)	Explain the procedure of converting FA to RE with example	L1	CO2	PO1

	b)	Minimize the following DFA 	L1	CO2	PO1
12	a)	Find the RE accepted by the following DFA 	L1	CO2	PO1
	b)	Check whether the given language L= { $a^n b^n$| n>=1} is regular or not	L2	CO2	PO2
13	a)	Convert the following FA into RE 	L1	CO2	PO1
	b)	Define Regular language with example.	L1	CO2	PO1
14	a)	List out the decision properties of Regular Language.	L1	CO2	PO1
	b)	Write an algorithm to build Regular expression from given DFA	L1	CO2	PO1
15	a)	Define Pumping Lemma. List the applications of pumping lemma.	L1	CO2	PO1
	b)	Show that $\{a^n b^{2n} \mid n>0\}$ is not Regular.	L1	CO2	PO1

UNIT–III

CONTEXT FREE GRAMMAR

S.No		Questions	BT	CO	PO
Part – A (Short Answer Questions)					
1		Define Context Free Grammar.	L5	CO3	PO1
2		Define Left Most Derivation with example.	L1	CO3	PO1
3		Define Right Most Derivation with example.	L1	CO3	PO1
4		What is Parse Tree? Explain with example.	L2	CO3	PO2
5		What are the applications of Context Free Grammar?	L1	CO3	PO1
6		What is Ambiguous Grammar?	L5	CO3	PO1
7		Define Push Down Automnata	L4	CO3	PO1
8		What is Deterministic Push Down Automata?	L1	CO3	PO1
9		What is Nondeterministic Push Down Automata?	L1	CO3	PO1
10		Differentiate between DPDA and NPDA		CO3	PO1
Part – B (Long Answer Questions)					
11	a)	Consider the following productions S → aB | bA	L1	CO3	PO1

		A → a | aS | bAA B → b | bS | aBB Derive aaabbabbba using Left Most Derivation& Draw Parse tree.			
	b)	List the steps to convert CFG to PDA	L1	CO3	PO1
12	a)	Construct a Push Down Automata for the language L={$a^n b^n$ | n>=0)	L1	CO3	PO1
	b)	Consider the following productions E →E+T/T T →T*F/F F →(E)/ID Derive id+id*id using Left Most Derivation &Right Most Derivation	L3	CO3	PO2
13	a)	Construct Push Down Automata for the language L={ wxw^R | w=(a,b)*	L1	CO3	PO1
	b)	What is Deterministic Push Down Automata. Explain with example.	L1	CO3	PO1
14	a)	Convert the given CFG to PDA S → 0S1 | A A → 1A0 | S | ε	L1	CO3	PO1
	b)	Find the parse tree for generating the string 11001010 from the given grammar S → 1B / 0A A → 1/1S/0AA B → 0/0S/1BB	L3	CO3	PO1
15	a)	Explain about derivation and parse trees? Construct the string 0100110 from the Leftmost and Rightmost derivation.	L1	CO3	PO2
	b)	Define Ambiguous grammar. Give an example	L3	CO3	PO1

UNIT–IV
NORMAL FORMS

S.No	Questions	BT	CO	PO
Part – A (Short Answer Questions)				
1	What is Normalization?	L5	CO4	PO1
2	How to eliminate unreachable symbols from CFG?	L3	CO4	PO1
3	How to eliminate ε-productions from the grammar?	L4	CO4	PO1
4	What is Chomsky Normal Form?	L3	CO4	PO2
5	List out the steps for pumping lemma for context free languages.	L4	CO4	PO1
6	How to eliminate Unit productions from the grammar?	L4	CO4	PO1
7	What is Griebech Normal Form?	L3	CO4	PO2
8	Define Turing Machine.	L2	CO4	PO2
9	What are the limitations of Turing Machine?	L3	CO4	PO1

10		Differentiate between Push Down Automata and Turing Machine.	L1	CO4	PO1
Part – B (Long Answer Questions)					
11	a)	Explain the Closure properties of Context Free Languages.	L1	CO4	PO1
	b)	Minimize the given CFG S →11A | B A → 0 | ε B → 0 | 1 T → 0A | 1B		CO4	PO2
12	a)	Explain the steps to convert CFG to CNF	L3	CO4	PO2
	b)	Convert the given CFG into CNF S → AaBb | abA A → ab | Bb B → bA | b	L1	CO4	PO2
13	a)	Explain the steps to convert CFG to GNF	L2	CO4	PO2
	b)	Convert the given CFG into GNF S → CA | BB B → b | SB C → b A → a	L3	CO4	PO1
14	a)	State and prove Pumping lemma for CFL.	L1	CO4	PO1
	b)	Show that L = $\{a^n b^n c^n \mid n>= 1\}$ is not a CFL	L1	CO4	PO1
15	a)	Define Turing Machine with example.	L1	CO4	PO1
	b)	Construct a Turing Machine for the following language L = $\{a^n b^n \mid n > 0\}$	L3	CO4	PO1

UNIT–V

TURING MACHINE

S.No	Questions	BT	CO	PO
Part – A (Short Answer Questions)				
1	List the different models in Turing Machine?	L2	CO5	PO1
2	What are the applications of Turing Machine?	L2	CO5	PO1
3	What are the required fields of an instantaneous description of a Turing machine?	L1	CO5	PO1
4	List the primary objectives of Turing Machine.	L2	CO5	PO1
5	List out the different techniques for turing machine construction.		CO5	PO1
6	What is a multi tape turing machine?	L4	CO5	PO1
7	What are the differences between a Finite automata and a Turing machine?	L2	CO5	PO1
8	What are the techniques for TM construction?	L2	CO5	PO1
9	Give examples for Undecidable Problems	L4	CO5	PO1

<table>
<tr><td colspan="2">10</td><td>Explain the properties of recursive languages</td><td>L4</td><td>CO5</td><td>PO1</td></tr>
<tr><td colspan="6"></td></tr>
<tr><td rowspan="2">11</td><td>a)</td><td>What is decidability of a problem? Explain in detail.</td><td>L2</td><td>CO5</td><td>PO2</td></tr>
<tr><td>b)</td><td>What is Post’s Correspondence Problem? Explain in detail.</td><td>L3</td><td>CO5</td><td>PO1</td></tr>
<tr><td rowspan="2">12</td><td>a)</td><td>Write a shot notes on post's correspondence problem and check thefollowing is PCP or not.
<table>
<tr><td>I</td><td>A</td><td>B</td></tr>
<tr><td>1</td><td>11</td><td>111</td></tr>
<tr><td>2</td><td>100</td><td>001</td></tr>
<tr><td>3</td><td>111</td><td>11</td></tr>
</table></td><td>L1</td><td>CO5</td><td>PO1</td></tr>
<tr><td>b)</td><td>Explain in detail about the types of Turing Machine.</td><td>L2</td><td>CO5</td><td>PO1</td></tr>
<tr><td rowspan="2">13</td><td>a)</td><td>What is halting problem and Turing reducibility ?</td><td>L2</td><td>CO5</td><td>PO1</td></tr>
<tr><td>b)</td><td>What is Turing Machine and Multi tape Turing Machine? Show that thelanguages accepted by these machines are same.</td><td>L1</td><td>CO5</td><td>PO2</td></tr>
<tr><td rowspan="2">14</td><td>a)</td><td>State Rice’s theorem.</td><td>L1</td><td>CO5</td><td>PO2</td></tr>
<tr><td>b)</td><td>Design Turing Machine for the language to accept the set of strings with equal number of 0’s and 1’s and also give the instantaneous description for theinput ‘110100’.</td><td>L3</td><td>CO5</td><td>PO1</td></tr>
<tr><td rowspan="2">15</td><td>a)</td><td>Show that the collection of all Turing machines is countable.</td><td>L2</td><td>CO5</td><td>PO2</td></tr>
<tr><td>b)</td><td>Mention the difference between decidable and undecidable problems.</td><td>L1</td><td>CO5</td><td>PO1</td></tr>
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* **Blooms Taxonomy Level (BT)**(L1 – Remembering; L2 – Understanding; L3 – Applying; L4 – Analyzing; L5 – Evaluating; L6 – Creating)

Course Outcomes (CO)

Program Outcomes (PO)

Prepared By: **HOD, CSE**

V. Preethi Reddy
Assistant Professor
CSE Department
Narasimha Reddy Engineering College