INSTITUTE OF AERONAUTICAL ENGINEERING

(Autonomous)

Dundigal, Hyderabad -500 043

Computer Science and Engineering

TUTORIAL QUESTION BANK

Course Name	**THEORY OF COMPUTATION**
Course Code	AIT002
Class	B. Tech IV Semester
Branch	Information Technology
Year	2018 – 2019
Course Faculty	Mr. P Anjaiah, Assistant Professor Ms. B Ramyasree, Assistant Professor Ms. E Umashankari, Assistant Professor Ms .A Jayanthi, Assistant Professor

COURSE OBJECTIVES (COs):

The course should enable the students to:

I.	Understand an overview of the theoretical foundations of computer science from the perspective of formal languages.
II.	Illustrate finite state machines to solve problems in computing.
III.	Understand the hierarchy of problems arising in the computer sciences.
IV.	Understand Regular grammars, context free grammar.
V.	Construct the model of Push down Automata, Turing Machines.

COURSE LEARNING OUTCOMES (CLOs):

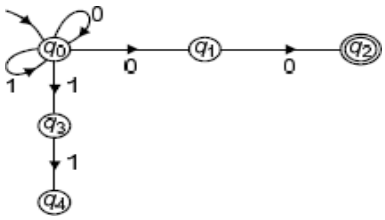
Students, who complete the course, will have demonstrated the asking to do the following:

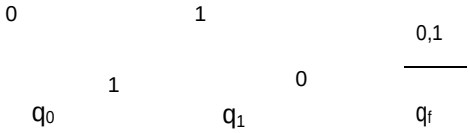
CAIT002.01	Use the definitions and notations for sets, relations and functions in defining and study Finite Automata
CAIT002.02	Remember on formal languages and Kleene's Theorem to intend programming languages
CAIT002.03	Construct deterministic and nondeterministic finite state automata (DFA and NFA) for solving simple decision problems.
CAIT002.04	Perform conversions between nondeterministic finite automata and deterministic finite automata and regular expressions and finite state automata to gain Remember about formal proofs in computer science
CAIT002.05	Remember on recursive definitions of regular languages, regular expressions and the use of regular expressions to represent regular languages
CAIT002.06	Detailed Remember on the relationship between regular expressions and finite automata
CAIT002.07	Identify that few languages are not regular by using Pumping lemma
CAIT002.08	Remember on Left Linear grammar, Right Linear grammars and converting grammars into Finite Automata.
CAIT002.09	Understand the fundamental role played by Context-Free Grammars (CFG) in designing formal computer languages with simple examples
CAIT002.10	Remember on Context-Free Grammars so that able to prove properties of Context-Free Grammars.

CAIT002.11	Identify relationship between regular languages and context-free grammars
CAIT002.12	Use the pumping lemma for Context Free Languages to show that a language is not context-free
CAIT002.13	Understand the equivalence between Context-Free Grammars and Non-deterministic Pushdown Automata
CAIT002.14	Understand deterministic Pushdown Automata to parse formal language strings by using (i) top down or (ii) bottom up techniques
CAIT002.15	Remember on converting Context-Free Grammars into pushdown automata to identify the acceptance of a string by the Context Free Language
CAIT002.16	Understand the path processing computation using Turing Machines (Deterministic and Non-Deterministic) and Church-Turing Thesis in computers.
CAIT002.17	Remember on non-halting Turing Machine accepted by Recursively Enumerable Languages
CAIT002.18	Understand the power of the Turing Machine, as an abstract automaton, that describes computation, effectively and efficiently
CAIT002.19	Theory of Computation is important in programming language design, parsers, web-scrappers, Natural Language Processing (NLP), and is at the heart of modern compiler architectures.
CAIT002.20	Process the remember and skills for employability and to succeed in national and international level competitive exams.

TUTORIAL QUESTION BANK

UNIT – I			
FINITE AUTOMATA			
PART – A (Short Answer Questions)			
S. No	Questions	Blooms Taxonomy Level	Course Learning Outcomes
1	Define Automata.	Remember	CAIT002.01
2	Distinguish between DFA and NFA.	Understand	CAIT002.03
3	Define String.	Remember	CAIT002.01
4	Describe transition function of DFA.	Understand	CAIT002.01
5	Define ε–transitions.	Remember	CAIT002.03
6	Explain power of an alphabet (∑*).	Understand	CAIT002.01
7	List the applications of finite automata.	Remember	CAIT002.01
8	Describe Null string.	Understand	CAIT002.01
9	Define Kleene Star?	Remember	CAIT002.01
10	Define NFA with example.	Remember	CAIT002.03
11	Describe transition diagram for DFA accepting string ending with 00	Understand	CAIT002.01
12	Construct DFA for a string accepting odd number of 0's.	Understand	CAIT002.03
13	Illustrate transition diagram for DFA to accept exactly one 'a' defined. over an alphabet ∑= {a,b}..	Understand	CAIT002.03
14	Construct DFA for odd number of 1's.	Remember	CAIT002.03
15	Define ε - closure.	Remember	CAIT002.03
16	Describe FSM and its structure with an example.	Understand	CAIT002.01
17	State the Mathematical definition of Finite Automata.	Remember	CAIT002.01
18	Construct DFA for even number of 1's.	Understand	CAIT002.01
19	Define DFA mathematically.	Remember	CAIT002.01
20	Construct DFA for the language accepting strings which contains 001 as substring.	Remember	CAIT002.03
Part - B (Long Answer Questions)			
1	Construct a DFA to accept set of all strings ending with 010.	Remember	CAIT002.03
2	Convert NFA with ε– a*b* to NFA.	Understand	CAIT002.04
3	Discuss various Differences between DFA and NFA	Understand	CAIT002.04
4	Describe NFA with ε to NFA conversion with an example.	Understand	CAIT002.04
5	Construct a DFA, the language recognized by the Automaton being L={w/ w does not contain the substring ab}.Draw the transition table.	Remember	CAIT002.03

6	Explain the properties of strings and languages.	Understand	CAIT002.01
7	Construct NFA for (0 + 1)*(00 + 11)(0 + 1)* and Convert to DFA.	Remember	CAIT002.04
8	Design DFA for the following languages shown below ∑ = { a,b} a) L={w/ w is any string that doesn't contain exactly two a} b) L={w/ w is any string except a and b}	Remember	CAIT002.03
9	Construct a DFA, the language recognized by the Automaton being L={w/ w contains neither the substring ab nor ba}.Draw the transition table.	Understand	CAIT002.04
	Part – C (Problem Solving and Critical Thinking Questions)		
1	Construct NFA for All strings such that the third symbol from the right end is a 0. (4 states)	Remember	CAIT002.04
2	Construct NFA for accepting any binary string that contains 11 as a substring and Convert to DFA.	Remember	CAIT002.04
3	Construct NFA for the set of all binary strings that have either the number of 0's odd, or the number of 1's not a multiple of 3, or both.	Remember	CAIT002.04
4	Write the DFA that will accept those words from ∑= {a, b} where the number of a's is divisible by two and the number of b's is divisible by three. Sketch the transition table of the finite automata	Understand	CAIT002.03
5	Construct DFA for the given NFA as shown in fig. below 	Remember	CAIT002.04
	UNIT – II		
	REGULAR LANGUAGES		
	PART – A (Short Answer Questions)		
S. No	Questions	Blooms Taxonomy Level	Course Learning Outcomes
1.	Define Regular Languages.	Remember	CAIT002.05
2.	List any two applications of regular expression.	Remember	CAIT002.05
3.	Define Pumping Lemma for Regular Languages.	Remember	CAIT002.07
4.	Give an example for a regular set?	Remember	CAIT002.05
5.	Construct the Regular Expression for the empty string.	Remember	CAIT002.08
6.	Describe regular expression for denoting language containing empty	Understand	CAIT002.05
7.	Define right linear grammars.	Remember	CAIT002.08
8.	Construct the Regular Expression for the set of binary strings.	Understand	CAIT002.05
9.	Define Regular grammars.	Remember	CAIT002.05
10.	List the advantages of regular expressions.	Remember	CAIT002.05
11.	Define Regular set?	Remember	CAIT002.05
12.	State regular expressions for the Set of strings over {0, 1} whose last two symbols are the same.	Remember	CAIT002.05
13.	Describe the regular language generated by regular expression (0+1)*001(0+1)*.	Understand	CAIT002.05
14	Summarize the difference between left linear and right linear	Understand	CAIT002.08
15.	Describe the Regular Expression to generate at least one b over Σ ={a,b}	Understand	CAIT002.05
	Part - B (Long Answer Questions)		
1	Convert Regular Expression 01* + 1 to Finite Automata.	Understand	CAIT002.08
2	Construct Right linear , Left linear Regular Grammars for 01*+1.	Remember	CAIT002.08

3	Discuss Identity rules. Simplify the Regular Expression - ϵ + 1*(011)*(1*(011)*)*.	Understand	
4	Construct Regular grammar for the given Finite Automata.(a+b)*ab*.	Understand	CAIT002.08
5	Construct Regular grammar for the given Finite Automata 0*11(0+1)*	Remember	CAIT002.08
6	Explain about the closure properties of regular sets	Understand	CAIT002.08
7	Construct Regular grammar for the given Finite Automata (0+1)*00(0+1)*	Remember	CAIT002.07
8	Convert Regular Expression (b+aa)*a* to Finite Automata.	Understand	CAIT002.05
9	State Pumping Lemma for Regular Languages with a suitable example.	Remember	CAIT002.07
	Part – C (Problem Solving and Critical Thinking Questions)		
1	Convert Regular Expression (11+0)*(00+1)* to Finite Automata.	Remember	CAIT002.08
2	Show that following languages are not regular L={$a^n b^m$ | n, m and n<m } L={ $a^n b^m c^m d^n$ | n, m } L={a^n | n is a perfect square }	Remember	CAIT002.05
3	What is the language accepted by the following Finite Automata 	Remember	CAIT002.06
	UNIT-III		
	CONTEXT FREE GRAMMARS		
	Part - A (Short Answer Questions)		
S. No	Questions	Blooms Taxonomy Level	Course Learning Outcomes
1	Define CFG.	Remember	CAIT002.10
2	Discuss about parse tree with example.	Understand	CAIT002.10
3	Define Rightmost derivation with example.	Remember	CAIT002.09
4	Write a short notes about leftmost derivation with example.	Remember	CAIT002.09
5	Mention any two applications of Context Free Grammar.	Understand	CAIT002.09
6	What is sentential form?	Remember	CAIT002.09
7	What are different ways to derive a string from a CFG.	Understand	CAIT002.09
8	What is the language generated by CFG or G?	Remember	CAIT002.09
9	What is parse tree?	Remember	CAIT002.09
10	What is subtree.	Remember	CAIT002.09
11	If S->aSb | aAb , A->bAa , A->ba. Find out the CFL	Understand	CAIT002.09
12	What is the use of normalization?	Remember	CAIT002.09
13	What is ambiguous grammar?	Remember	CAIT002.09
14	Define nullable Variable.	Remember	CAIT002.09
15	Explain the elimination of UNIT production.	Understand	CAIT002.10
16	Explain the elimination of useless symbols in productions.	Understand	CAIT002.10
17	Write the minimization of CFG – S → a S/A A ->a / B	Remember	CAIT002.10
18	Define the ambiguity in CFG.	Understand	CAIT002.10
19	What is the use of CNF and GNF.	Remember	CAIT002.10
20	Write the minimization of CFG - S → aS1b S1→aS1b/ε.	Understand	CAIT002.10
21	Write the minimization of CFG - S → A A →aA/ ε.	Understand	CAIT002.10
22	Write the minimization of CFG - S →AB / a A → a. B→b	Understand	CAIT002.10
23	Write the minimization of CFG - S→aS/A/C A →a B→aa C→aCb.	Understand	CAIT002.10

24	Write the minimization of CFG - S→AbA A→Aa/ ε.	Understand	CAIT002.10
25	Write the minimization of CFG - S→aSa S →bSb S→a/b/ ε.	Understand	CAIT002.10
26	Write the minimization of CFG - S→A0/B A→0/12/B	Understand	CAIT002.10
27	Convert the grammar to CNF - S→aSa/aa S→bSb/bb S →a/b.	Understand	CAIT002.10
28	Convert the grammar to CNF - S→aAbB A→aA/a B→bB/a.	Understand	CAIT002.10
	Part – B (Long Answer Questions)		
1.	Construct Leftmost Derivation. , Rightmost Derivation, Derivation Tree for the following grammar with respect to the string aaabbabbba. S→ aB | bA A→ aS| bAA|a B→ bS | aBB | b	Remember	CAIT002.10
2.	Design a CFG for the languages L= $\{a^i b^j \mid i<=2j\}$	Understand	CAIT002.10
3.	Construct leftmost and rightmost derivations for the strings, if the language is given as S→AS| ε A→aa|ab|ba|bb Strings: a) aabbba b) baabab c) aaabbb	Remember	CAIT002.10
4.	Write short notes on Chomsky Normal Form and Greibach Normal Form.	Understand	CAIT002.10
5.	What is Normalization of CFG? What is the use of Normalization? Explain different types of normal forms.	Remember	CAIT002.10
6.	Illustrate the construction of Greibach normal form with an example.	Understand	CAIT002.10
7.	Show that the following CFG ambiguous. S→ iCtS | iCtSeS | a C→ b.	Understand	CAIT002.12
8.	Discuss the Pumping lemma for Context Free Languages concept with example $\{a^n b^n c^n$ where n>=0$\}$.	Understand	CAIT002.12
9.	Write the simplified CFG productions in S → a S1b S1 → a S1b/ Є	Understand	CAIT002.12
10	Convert the following CFG into GNF. S→AA/a A → SS/b	Remember	CAIT002.12
11	Explain unit production? Explain the procedure to eliminate unit production.	Understand	CAIT002.12
12	Explain the procedure to eliminate ϵ-productions in grammar.	Understand	CAIT002.12
13.	Convert the following grammar into GNF G=({A1,A2,A3},{a,b},P,A) A1→A2A3 A2→A3A1/b A3→A1A2/a	Understand	CAIT002.12
14.	Write simplified CFG productions from the following grammar A→aBb/bBa B→aB/bB/ϵ	Understand	CAIT002.12

15.	Convert the following grammar into GNF S→ABA/AB/BA/AA/B A→aA/a B→bB/b	Understand	CAIT002.12
16	Write the minimized CFG for the following grammar S→ABCa | bD A→BC |b B→b | ε C→Đ| ε D→d	Understand	CAIT002.12
	Part – C (Problem Solving and Critical Thinking Questions)		
1.	Design a grammar for valid expressions over operator - and /. The arguments of expressions are valid identifiers over symbols a,b, 0 and 1. Derive Left Most Derivation and Right Most Derivation for string W= (a11-b0) / (b00-a01). Draw parse tree for Left Most Derivation.	Understand	CAIT002.12
2.	Convert the following grammar into GNF A1→A2 A3 A2→A3 A1 /b A3→A1 A2 /a	Understand	CAIT002.12
3.	Use the following grammar : S→ABC | BbB A→ aA |BaC|aaa B→ bBb| a|D C→CA|AC D→ε Eliminate ε-productions. Eliminate any unit productions in the resulting grammar. Eliminate any useless symbols in the resulting grammar. Convert the resulting grammar into Chomsky Normal Form	Remember	CAIT002.12
	UNIT-IV		
	PUSHDOWN AUTOMATA		
	Part – A (Short Answer Questions)		
S. No	Questions	Blooms Taxonomy Level	Course Learning Outcomes
1.	Differentiate between deterministic and nondeterministic PDA.	Understand	CAIT002.13
2.	Define PDA.	Remember	CAIT002.14
3.	Define NPDA.	Remember	CAIT002.14
4.	Define the language of DPDA.	Remember	CAIT002.14
5.	Convert the following PDA to CFG δ(q0,0,z0)={q0,xz0)	Understand	CAIT002.15
6.	Convert the following PDA to CFG δ(q0,0,x)=(q0,xx)	Understand	CAIT002.15
7.	Convert the following PDA to CFG δ(q0,1,x)=(q1,ϵ)	Understand	CAIT002.15
8.	Convert the following PDA to CFG δ(q1,1,x) = (q1,ϵ)	Understand	CAIT002.15
9.	List the steps to convert CFG to PDA.	Remember	CAIT002.15
10.	Explain acceptance of PDF by final state.	Understand	CAIT002.14
11.	Explain acceptance of PDF by empty stack.	Understand	CAIT002.14

12.	Convert the following PDA to CFG δ(q0,b,z0)={q0,zz0)	Understand	CAIT002.14
13.	Convert the following PDA to CFG δ(q0,b,z) = (q0,zz)	Understand	CAIT002.14
14.	Convert the following PDA to CFG δ(q0, ϵ ,z0)=(q0,ϵ)	Understand	CAIT002.15

Part – B (Long Answer Questions)

S. No	Questions	Blooms Taxonomy Level	Course Learning Outcomes
1.	Is NPDA(Nondeterministic PDA) and DPDA(deterministic PDA) equivalent? Illustrate with an example.	Understand	CAIT002.13
2.	Construct the grammar for the following PDA. M=({q0, q1},{0,1},{X,z0},δ,q0,Z0,Φ) and where δ is given by δ(q0,0,z0)={(q0,XZ0)}, δ(q0,0,X)={(q0,XX)},δ(q0,1,X)={(q1, ε)}, δ(q1,1,X)={(q1, ε)},δ(q1, ε,X)={(q1, ε)}, δ(q1, ε, Z0)={(q1, ε)}.	Remember	CAIT002.15
3.	Construct PDA for string of form a^nb^{2n}	Understand	CAIT002.14
4.	Define PDA mathematically. With a neat diagram explain the working of a Turing Machine	Understand	CAIT002.14
5.	Write the PDA that accepts the language {a^m b^n/n>m}	Remember	CAIT002.14
6.	Design a PDA for the following grammar S→0A A→0AB/1 B→1	Understand	CAIT002.14
7.	Convert the following PDA to CFG M=({q0,q1},{a,b},{z0,za}, δ,q0,z0,Φ) δ is given by, δ(q0,a,z0)=(q0,zz) δ(q0,a,z)=(q0,zz0) δ(q0,b,z)=(q1,ϵ) δ(q1,b,z)=(q1,ϵ) δ(q1,ϵ,z0)=(q1,ϵ)	Understand	CAIT002.14
8.	Define PDA mathematically. Construct the PDA for the following language. *L= {w /w of form a^nb^n}.*	Remember	CAIT002.14

Part – C (Problem Solving and Critical Thinking Questions)

S. No	Questions	Blooms Taxonomy Level	Course Learning Outcomes
1	Construct PDA for equal number of x's and y's. eg:xyyxxy	Remember	CAIT002.14
2	Construct NDPDA for L = { $W\#W^R$ /W ϵ (X + Y)*}	Remember	CAIT002.14
3	Convert the following PDA to CFG δ(q0,0,z0)={q0,xz0) δ(q0,0,x)=(q0,xx) δ(q0,1,x)=(q1,ϵ) δ(q1,1,x) = (q1,ϵ) δ(q1,ϵ,x)=(q1,ϵ) δ(q1,ϵ,z0)=(q1,ϵ)	Understand	CAIT002.15
4	Construct DPDA for L = { $W\#W^R$ /W ϵ (X + Y)*}	Understand	CAIT002.15

UNIT-V			
TURING MACHINE			
Part - A (Short Answer Questions)			
S. No	**Questions**	**Blooms Taxonomy Level**	**Course Learning Outcomes**
1	Define Chomsky hierarchy of languages.	Remember	CAIT002.16
2	Define Context sensitive language.	Remember	CAIT002.16
3	Define Turing Machine	Remember	CAIT002.16
4	Define Type 0 grammars .	Remember	CAIT002.16
5	Define Type 1 grammars .	Remember	CAIT002.16
6	Define Type 2 grammars .	Remember	CAIT002.16
7	Define Type 3 grammars .	Remember	CAIT002.16
8	List the types of grammars.	Remember	CAIT002.16
9	Explain the moves in Turing Machine.	Understand	CAIT002.16
10	Define an Instantaneous Description of a Turing Machine.	Remember	CAIT002.16
11	Define the Language of Turing Machine.	Remember	CAIT002.17
12	List types of TM.	Remember	CAIT002.18
13	Distinguish the difference between Pushdown Automata and Turing	Understand	CAIT002.18
14	Define multi head Turing Machine.	Remember	CAIT002.16
15	Define multi dimensional Turing Machine.	Remember	CAIT002.16
16	Define multiple tapes Turing Machine.	Remember	CAIT002.16
17	Define Recursive languages.	Remember	CAIT002.17
18	Define Recursively enumerable languages.	Remember	CAIT002.17
19	Define Two way infinite Turing Machine.	Remember	CAIT002.16
20	Define Non deterministic Turing Machine.	Remember	CAIT002.16
21	Construct Turing Machine for 1's complement for binary numbers.	Understand	CAIT002.16
22	Differentiate Recursive languages and Recursively enumerable languages.	Understand	CAIT002.16
23	Explain Church's Hypothesis.	Understand	CAIT002.16
Part - B (Long Answer Questions)			
1	Write short notes on Context sensitive language and linear bounded automata.	Remember	CAIT002.16
2	Write briefly about Chomsky hierarchy of languages..	Remember	CAIT002.16
3	Define a Turing Machine. With a neat diagram explain the working of a Turing Machine.	Remember	CAIT002.16
4	Differentiate Turing Machine with other automata.	Understand	CAIT002.18
5	Construct a Transition diagram for Turing Machine to accept the language L= { $w\#w^R \mid w \in (a + b)^*$}	Understand	CAIT002.17
6	Write short notes on Recursive and Recursively Enumerable languages.	Understand	CAIT002.17
7	Write the properties of recursive and recursively enumerable languages.	Understand	CAIT002.17
8	Construct a Turing Machine to accept strings formed with 0 and 1 and having substring 000.	Understand	CAIT002.16
9	Construct a Transition diagram for Turing Machine to accept the language L= { $ww^R \mid w \in (a + b)^*$}	Understand	CAIT002.16
10	Construct Transition table for TM L={$a^nb^nc^n/n>=1$}	Remember	CAIT002.16
11	Construct a Transition table for Turing Machine to accept the following language. L = { $0^n1^n0^n \mid n \geq 1$}	Remember	CAIT002.16
12	Construct a Turing Machine that accepts the language L = {$1^n2^n3^n \mid n \geq 1$}. Give the transition diagram for the Turing Machine obtained and also show the moves made by the Turing machine for the string 111222333.	Remember	CAIT002.16

13	Define Linear bounded automata and explain its model?	Understand	CAIT002.16
14	Explain the power and limitations of Turing machine.	Understand	CAIT002.18
15	Construct Transition diagram for Turing Machine - $L=\{a^nb^nc^n/n>=1\}$	Remember	CAIT002.16
16	Construct a Transition diagram for Turing Machine to implement addition of two unary numbers(X+Y).	Remember	CAIT002.16
17	Construct a Linear Bounded automata for a language where $L=\{a^nb^n/n>=1\}$	Remember	CAIT002.16
18	Explain the types of Turing machines.	Understand	CAIT002.18
19	Write briefly about the following a)Church's Hypothesis b)Counter machine	Understand	CAIT002.16
20	Construct Transition diagram for Turing Machine that accepts the language $L = \{0^n1^n \mid n \geq 1\}$. Give the transition diagram for the Turing Machine obtained and also show the moves made by the Turing machine for the string 000111.	Remember	CAIT002.16
	Part – C (Problem Solving and Critical Thinking Questions)		
1	Construct a Turing Machine that accepts the language $L = \{a^{2n}b^n \mid n \geq 0\}$.Give the transition diagram for the Turing Machine obtained.	Remember	CAIT002.16
2	Construct a Turing Machine that gives two's compliment for the given binary representation.	Remember	CAIT002.16
3	Explain Type 3 and Type 2 grammars with example.	Understand	CAIT002.05
4	Explain Type 1 and Type 0 grammars with example.	Understand	CAIT002.17
5	Construct a Turing Machine to accept the following language. $L = \{ w^nx^ny^nz^n \mid n \geq 1\}$	Remember	CAIT002.16

Prepared by:

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HOD,CSE.