Syllabus for B.Tech Admission Batch2022

Subject Name: Theory of Computations   **Credit: 3**   **LectureHours:36**

Subject Code: PCCCS502

Pre-requisite: Elementary discrete mathematics includes the notion of set, function, relation, product, partial order, equivalence relation, graph & tree. They should have a thorough understanding of the principle of mathematical induction.

Relevant Links:

Study Material   Coursera   NPTEL   LinkedIn Learning   InfosysSpringboard

COURSE OBJECTIVES:
1. Understand models and abstractions: automata as a basic model of computation
2. Link between languages, automata, and decision problems.
3. Understand product, union, closure properties and algebraic formalisms of languages such as regular expressions, context-free grammar.
4. Understand algorithms and computability through the lens of Turing machines.

COURSE OUTCOMES:

CO 1: After studying Finite Automata, student will be able to define a system and recognize the behavior of a system. They will be able to minimize a system and compare different systems.

CO2: After studying regular language and grammar student will convert Finite Automata to regular expression. Students will be able to check equivalence between regular linear grammar and FA.

CO3: After studying CFG and PDA Students will be able to minimize context free grammar. Student will be able to check equivalence of CFL

and PDA. They will be able to design.
CO4: After studying turing machine Students will be able to design Turing machine.

Module number	Topic	Sub-topics	Text Book Name & Chapter Number	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignment
1	**Finite Automaton**	Introduction to concepts of alphabet, language, production rules, grammar and automaton, finite state model, introduction to the concept of Chomosky Classification of Grammar, language generation from production rules and vice- versa; Concept of DFA and its problems, concept of NFA and its problems. NFA to DFA conversion, Construction of DFA & NFA for any given string and vice versa, Minimization of FA and equivalence of two FA, Mealy & moore machine and their problems. Limitations of FSM.	T2-Ch1, Ch2, Appendix A	*International Academia:* (https://ocw.mit.edu/courses/18-404j-theory-of-computation-fall-2020/pages/syllabus/) *AICTE-prescribed syllabus:* (https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf) *Industry Mapping:* JFLAP, VAS, TAGS and SimStudio	9	1. Design a Finite State Machine (FSM) that accepts all strings over input symbols {0, 1} having three consecutive 1's as a substring. 2. Design a Finite State Machine (FSM) that accepts all strings over input symbols {0, 1}

						which are divisible by 3. 3. Design a Finite State Machine (FSM) that accepts all decimal string which are divisible by 3.
2	**Regular Languages and Regular Grammars**	Regular language and regular expressions, identity rules. Arden's theorem state and prove, Construction of NFA from regular expression, Conversion of NFA with null moves to without null moves, closure properties, pumping lemma and its applications, proof of pumping lemma.	T2- Ch3, Ch4	**International Standards** :(https://ocw.mit.edu/courses/18-404j-theory-of-computation-fall-2020/pages/syllabus/)	9	

				AICTE prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf) *Industry Mapping:* JFLAP, VAS, TAGS and SimStudio		
3	**Context-free Languages and machine models.**	Introduction to Context Free Grammer, Derivation trees, sentential forms. Right most and leftmost derivation of strings, concepts of ambiguity. Minimization of CFG, Chomsky normal form, Greibach normal form, Pumping Lemma for Context Free Languages, Enumeration of properties of CFL (proofs included). Closure property of CFL, Ogden's lemma & its applications, Push Down Automata: Push down automata, definition and description, Acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence, Equivalence of CFL and PDA, interconversion, DCFL and DPDA.	T1- Ch5, Ch6	*International Standards*: (https://ocw.mit.edu/courses/18-404j-theory-of-computation-fall-2020/pages/syllabus/) *AICTE prescribed syllabus:* (https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf) *Industry Mapping:* JFLAP, VAS, TAGS and SimStudio	10	1. Design a Push Down Automata (PDA) that accepts all string having equal number of 0's and 1's over input symbol {0, 1} for a language 0n1n where n >= 1. 2. Design a Program to create PDA machine

						that accept the well-formed parenthesis.

| 4 | **Turing machines and Computability** | Turing Machine : Turing Machine, definition, model, Design of TM, Computable functions, Church's hypothesis, counter machine, Types of Turing machines (proofs not required), Universal Turing Machine, Halting problem, P, NP. Recursively enumerable (r.e.) and recursive languages. Existence of non-r.e. languages. Notion of undecidable problems. Universal language and universal TM. Separation of recursive and r.e. classes. | T3- Part 2 – Ch3, Ch4 | *International Standards:* (https://ocw.mit.edu/courses/18-404j-theory-of-computation-fall-2020/pages/syllabus/)

AICTE prescribed syllabus: (https://www.aicte-india.org/sites/default/files/Model_Curriculum/AICTE%20-%20UG%20CSE.pdf)

Industry Mapping: JFLAP, VAS, TAGS and SimStudio | 8 | 1. Design a Turing Machine that calculate 2's complement of given binary string.
2. Design a Turing Machine which will increment the given binary number by 1. |

TEXT BOOK:

T1. Introduction to Automata, Theory, Languages and Computation. Third Edition. John Hopcroft, Rajeev Motwani, Jeffrey D. Ullmann, Pearson Publications (Low-cost Indian edition available).

T2. Peter Linz, An Introduction to Formal Languages and Automata, Narosa Pub. House, 2011

T3. Introduction to the Theory of Computation, 3rd edition. Michael Sipser, Cengage Publications (Lowcost Indian edition available).

REFERENCEBOOKS:

1. Automata and Computability, Dexter C. Kozen. Part of the Undergraduate Texts in Computer Science book series (UTCS), Springer.

2. Elements of the Theory of Computation, 2nd edition. Harry Lewis, Christos Papadimitriou, Prentice

3. Dr. R.B.Patel, Theory of Computation, Khanna Publishing House