



University of Engineering & Management, Kolkata
University of Engineering & Management, Jaipur
Institute of Engineering & Management, Kolkata
Department of Computer Science

DETAILED SYLLABUS

Course Code- PCCCS502

Course Title – Theory of Computations

Credit – 3

Category – Professional Core Course

Semester – V

L:T:P:S – 3:0:0:0

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.

Course Outcomes:

CO1	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 equivalence between regular linear grammar and FA.
CO4	After studying turing machine Students will be able to design Turing machine.

Study Material	Coursera	NPTEL	Linkedin Learning	Infosys Springboard
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Module No.	Topic	Sub-topics	Mapping with Industry and International Academia	Lecture Hours	Corresponding Lab Assignments	Textbook Mapping
1	Finite Automata	Introduction to concepts of alphabet, language, production rules, grammar and automaton, finite state model, introduction to the concept of Chomsky 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	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.	Text Book 2: Chapters: 1 and 2; Appendix A

		and their problems. Limitations of FSM.				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.	International Academia: https://ocw.mit.edu/courses/18-404i-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		Text Book 2: Chapters: 3 and 4;	
3	Context free Languages and machine models.	Introduction to Context Free Grammar, Derivation trees, sentential forms. Right most and leftmost derivation of strings, concepts of ambiguity. Minimization of CFG, Chomsky normal form, Greibach normal	International Academia: https://ocw.mit.edu/courses/18-404i-theory-of-computation-fall-2020/pages/syllabus/	10		Text Book 1: Chapters: 5 and 6;	1. Design a Push Down Automata (PDA) that accepts all string having equal number of 0's and 1's

		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.	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		over input symbol $\{0, 1\}$ for a language $0^n 1^n$ where $n \geq 1$. 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	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	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 3: Chapters: 3 and 4;

		universal TM. Separation of recursive and r.e. classes.	<i>JFLAP, VAS, TAGS and SimStudio</i>			
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Textbooks:

1. Introduction to Automata, Theory, Languages and Computation. Third Edition. John Hopcroft, Rajeev Motwani, Jeffrey D. Ullmann, Pearson Publications (Low-cost Indian edition available).
2. Peter Linz, An Introduction to Formal Languages and Automata, Narosa Pub. House, 2011
3. Introduction to the Theory of Computation, 3rd edition. Michael Sipser, Cengage Publications (Lowcost Indian edition available).

Reference books:

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