

Savitribai Phule Pune University Third Year of Computer Engineering (2015 Course) 310241: Theory of Computation		
Teaching Scheme: TH: 03 Hours/Week	Credit 03	Examination Scheme: In-Sem (Paper): 30 Marks End-Sem (Paper): 70 Marks
Prerequisite Courses: Discrete Mathematics (210241), Principles of Programming Languages (210254)		
Course Objectives: <ul style="list-style-type: none"> To Study abstract computing models To learn Grammar and Turing Machine To learn about the theory of computability and complexity. 		
Course Outcomes: On completion of the course, student will be able to– <ul style="list-style-type: none"> Able to design deterministic Turing machine for all inputs and all outputs Able to subdivide problem space based on input subdivision using constraints Able to apply linguistic theory 		
Course Contents		
Unit I	Formal Language Theory and Finite Automata	08 Hours
Introduction to Formal language, introduction to language translation logic, Essentials of translation, Alphabets and languages, Finite representation of language, Finite Automata (FA): An Informal Picture of FA, Finite State Machine (FSM), Language accepted by FA, Definition of Regular Language, Deterministic and Nondeterministic FA(DFA and NFA), epsilon- NFA, FA with output: Moore and Mealy machines -Definition, models, inter-conversion. Case Study: FSM for vending machine, spell checker		
Unit II	Regular Expressions (RE)	07 Hours
Operators of RE, Building RE, Precedence of operators, Algebraic laws for RE, Conversions: NFA to DFA, RE to DFA Conversions: RE to DFA, DFA to RE Conversions: State/loop elimination, Arden's theorem Properties of Regular Languages: Pumping Lemma for Regular languages, Closure and Decision properties. Case Study: RE in text search and replace		
Unit III	Context Free Grammars (CFG) and Languages	08 Hours
Introduction, Regular Grammar, Context Free Grammar - Definition, Derivation, Language of grammar, sentential form, parse tree, inference, derivation, parse trees, ambiguity in grammar and Language- ambiguous Grammar, Simplification of CFG : Eliminating unit productions, useless production, useless symbols, and ϵ -productions, Normal Forms - Chomsky normal form, Greibach normal form, Closure properties of CFL, Decision properties of CFL, Chomsky Hierarchy, Application of CFG : Parser, Markup languages, XML and Document Type Definitions. Case Study- CFG for Palindromes, Parenthesis Match,		
Unit IV	Turing Machines (TM)	08 Hours

Turing Machine Model, Representation of Turing Machines, Language Acceptability by Turing Machines, Design of TM, Description of TM, Techniques for TM Construction, Variants of Turing Machines, The Model of Linear Bounded Automata, TM & Type 0 grammars, TM's Halting Problem.

Unit V	Pushdown Automata(PDA)	07 Hours
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Basic Definitions, Equivalence of Acceptance by Finite State & Empty stack, PDA & Context Free Language, Equivalence of PDA and CFG, Parsing & PDA: Top-Down Parsing, Top-down Parsing Using Deterministic PDA, Bottom-up Parsing, Closure properties and Deterministic PDA.

Unit VI	Undecidability & Intractable Problems	07 Hours
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A Language that is not recursively enumerable, An un-decidable problem that is RE, Post Correspondence Problem, The Classes P and NP : Problems Solvable in Polynomial Time, An Example: Kruskal's Algorithm, Nondeterministic Polynomial Time, An NP Example: The Traveling Salesman Problem, Polynomial-Time Reductions NP Complete Problems, An NP-Complete Problem: The Satisfiability Problem, Tractable and Intractable Representing SAT Instances, NP Completeness of the SAT Problem, A Restricted Satisfiability Problem: Normal Forms for Boolean Expressions, Converting Expressions to CNF, The Problem of Independent Sets, The Node-Cover Problem.

Books:

Text:

1. John E. Hopcroft, Rajeev Motwani, Jeffrey D.Ullman, "Introduction to Automata Theory Languages and Computation", Addison-Wesley, ISBN 0-201-44124-1.
2. H.L. Lewis, Christos H. Papadimitriou, "Elements of the Theory of Computation", Prentice Hall, ISBN-10: 0132624788; ISBN-13: 978-0132624787

References:

1. John Martin, "Introduction to Languages of The Theory of Computation", 2nd Edition, McGraw Hill Education, ISBN-13: 978-1-25-900558-9, ISBN-10: 1-25-900558-5
2. Sanjeev Arora and Boaz Barak, "Computational Complexity: A Modern Approach", Cambridge University Press, ISBN:0521424267 9780521424264
3. Daniel Cohen, "Introduction to Computer Theory", Wiley & Sons, ISBN 9788126513345
4. J. Carroll & D Long, "Theory of Finite Automata", Prentice Hall, ISBN 0-13-913708-4
5. Kavi Mahesh, "Theory of Computation : A Problem-Solving Approach", Wiley India, ISBN10 8126533110
6. Michael Sipser, "Introduction to the Theory of Computation", Cengage Learning, ISBN-13: 9781133187813
7. Vivek Kulkarni "Theory of Computation", Oxford University Press, ISBN 0-19-808458