# PRASAD V. POTLURI SIDDHARTHA INSTITUTE OF TECHNOLOGY

(Autonomous)

Kanuru, Vijayawada-520007

## DEPARTMENT OF COMPUTER SCIENCE AND ENGINEERING (Data Science)

### III B. Tech I Semester

### Automata Theory & Compiler Design

| Course Code | 23DS4501A | Year | III | Semester | I |
|---|---|---|---|---|---|
| Course Category | PEC | Branch | CSE (Data Science) | Course Type | Theory |
| Credits | 3 | L-T-P | 3-0-0 | Prerequisites | Discrete mathematics |
| Continuous Internal Evaluation | 30 | Semester End Evaluation | 70 | Total Marks | 100 |

| Course Outcomes | |
|---|---|
| **Upon Successful completion of course, the student will be able to** | |
| CO1 | Describe automata, formal languages, Turing machines, and compiler phases to understand the foundations of computation and compiler design | **L2** |
| CO2 | Apply regular expressions and context-free grammars to define and analyze programming language construct | **L3** |
| CO3 | Apply lexical and syntax analysis techniques to generate intermediate code and manage runtime environments in compiler design. | **L3** |
| CO4 | Analyze the behavior of Turing machines, syntax-directed translation, and runtime environment management to understand language processing and program execution. | **L4** |

**Contribution of course outcomes towards achievement of program outcomes & Strength of correlations (3: Substantial,2: Moderate,1: Slight)**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | P010 | PO11 | PSO1 | PSO2 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| CO1 | 2 | | | | | | | | | | | | |
| CO2 | 3 | | | | | | | | | | | | |
| CO3 | 3 | | | | | | | | | | | | |
| CO4 | | 3 | | | | | | | | | 2 | | |

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| Unit No | Contents | Mapped CO |
|---|---|---|
| **Syllabus** | | |
| **I** | **Introduction to Finite Automata:** Structural Representations, Automata and Complexity, the Central Concepts of Automata Theory – Alphabets, Strings, Languages, Problems. Nondeterministic Finite Automata: Formal Definition, an application, Text Search, Finite Automata with Epsilon-Transitions. Deterministic Finite Automata: Definition of DFA, How A DFA Process Strings, The language of DFA, Conversion of NFA with €-transitions to NFA without €-transitions. Conversion of NFA to DFA. | CO1 |
| **II** | **Regular Expressions:** Finite Automata and Regular Expressions, Applications of Regular Expressions, Algebraic Laws for Regular Expressions, Conversion of Finite Automata to Regular Expressions. Pumping Lemma for Regular Languages: Statement of the pumping lemma, Applications of the Pumping Lemma. Context-Free Grammars: Definition of Context-Free Grammars, Derivations Using a Grammar, Leftmost and Rightmost Derivations, the Language of a Grammar, Parse Trees, Ambiguity in Grammars and Languages. | CO1, CO2 |
| **III** | **Push Down Automata:** Definition of the Pushdown Automaton, the Languages of a PDA, Equivalence of PDA's and CFG's, Acceptance by final state Turing Machines: Introduction to Turing Machine, Formal Description, Instantaneous description, The language of a Turing machine Undecidability: Undecidability, A Language that is Not Recursively Enumerable, An Undecidable Problem That is RE, Undecidable Problems about Turing Machines. | CO1, CO2, CO4 |
| **IV** | **Introduction:** The structure of a compiler, Lexical Analysis: The Role of the Lexical Analyzer, Input Buffering, Recognition of Tokens, The Lexical- Analyzer Generator Lex. **Syntax Analysis:** Introduction, Context-Free Grammars, Writing a Grammar, Top-Down Parsing, Bottom- Up Parsing. **Introduction to LR Parsing:** Simple LR, More Powerful LR | CO1, CO3, CO4 |
| **V** | **Syntax-Directed Translation:** Syntax-Directed Definitions, Evaluation Orders for SDD's, Syntax Directed Translation Schemes, Implementing L-Attributed SDD's. Intermediate-Code Generation: Variants of Syntax Trees, Three-Address Code Run-Time Environments: Stack Allocation of Space, Access to Nonlocal Data on the Stack, Heap Management | CO1, CO3, CO4 |

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| Learning Resources |
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| **Text Books** |
| 1. Introduction to Automata Theory, Languages, and Computation by John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, 3rd Edition, 2006, Pearson Education. |
| 2. Compilers: Principles, Techniques and Tools by Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, 2nd Edition, 2006, Pearson. |
| 3. Theory of Computer Science – Automata, Languages and Computation by K.L.P. Mishra and N. Chandrasekaran, 2nd Edition, 2001, PHI Learning. |
| **References** |
| 1. Introduction to Formal Languages, Automata Theory and Computation by Kamala Krithivasan and Rama R, 1st Edition, 2009, Pearson Education. |
| 2. Introduction to Languages and the Theory of Computation by John C. Martin, 4th Edition, 2010, McGraw-Hill (TMH). |
| 3. Lex & Yacc by John R. Levine, Tony Mason, and Doug Brown, 2nd Edition, 1992, O'Reilly Media. |
| 4. Compiler Construction by Kenneth C. Louden, 1st Edition, 1997, Course Technology, Thomson Learning. |
| **E-Recourses and other Digital Material** |
| 1. https://nptel.ac.in/courses/106/106106049 |
| 2. https://www.youtube.com/playlist?list=PL85CF9F4A047C7BF7 |