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| **Semester: V** | | | | | | | |
| **FINITE AUTOMATA AND FORMAL LANGUAGES**  **(Theory)** | | | | | | | |
| **Course Code** | | **:** | 18CS52 |  | **CIE Marks** | **:** | 100 |
| **Credits: L:T:P** | | : | 3:0:0 |  | **SEE Marks** | **:** | 100 |
| **Total Hours** | | : | 39L |  | **SEE Duration** | **:** | 3 Hrs |
| **Course Learning Objectives:** The students will be able to | | | | | | | |
|  | Understand fundamental concepts of theory of computation and the use of mathematical thinking as it is applied to Computer Science. | | | | | | |
|  | Compare finite automata; push down automata and Turing machines as Mathematical models of computation. | | | | | | |
|  | Develop the concepts and skills necessary to be able to evaluate the computability and complexity of practical computational problems. | | | | | | |
|  | Understand formal thought processes, computation, algorithms and their limits. | | | | | | |
|  | Design a machine model to accept a specified language | | | | | | |

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| **Unit – I** | **8 Hrs** |
| Regular Languages and Regular Expressions, Memory Required to Recognize a Language, Deterministic Finite Automata (DFA), Non Deterministic Finite Automata (NFA), Non Deterministic Finite Automata with ϵ -transitions (NFA-ϵ), Equivalence, Regular Expressions and Finite Automata, Applications of Regular Expressions, Algebraic laws of Regular Expressions, Minimization of Finite Automata. | |
| **Unit – II** | **8 Hrs** |
| Pumping Lemma for Regular Languages, Closure properties of Regular Languages, Decision properties of Regular languages, Context-free grammars (CFG), Parse trees, Applications, Ambiguity in grammars & languages, Simplification of CFG, Normal forms of CFGs. Regular Grammars, Equivalence of Regular Grammars and Finite Automata. | |
| **Unit – III** | **8 Hrs** |
| Push Down Automata (PDA): Definition, the languages of a PDA, Equivalence of PDA’s & CFG’s, Deterministic PDA. The Pumping Lemma for Context Free Languages (CFL), Closure properties of CFLs, Decision properties of CFLs | |
| **Unit – IV** | **8 Hrs** |
| Turing Machines (TM): Definitions and Examples, TM as a Language Accepter, Computing Partial Functions with Turing Machine, Variations of Turing Machines, Combining Turing Machines, Non Deterministic TM, Universal TM, Recursively Enumerable Languages (REL) and Recursive Languages. Properties of REL and Recursive Languages. | |
| **Unit – V** | **7 Hrs** |
| More General Grammars, Unrestricted Grammar, Context Sensitive Languages (CSL) and Linear Bounded Automata (LBA), Chomsky Hierarchy, Not all languages are Recursively Enumerable, Unsolvable Problem, Reducing One problem to another, The halting problem of TM, Post's Correspondence Problem (PCP), Time and Space Complexity of TM. | |

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| **Course Outcomes: After completing the course, the students will be able to** | |
|  | Understand the fundamental concepts of theory of computations. |
|  | Analyze the tools of finite automata to various fields of computer science. |
|  | Design solution model for complex problems, using the appropriate skills of automata theory for better results. |
|  | Apply automata skills in situations that describe computation effectively and efficiently. |

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| **Reference Books:** | |
|  | Introduction to Languages & Theory of Computation, John C Martin, Tata McGraw-Hill, 4th Edition, 2011 ISBN: 978-0-07-319146-1. |
|  | Introduction to Automata Theory, Languages & Computation, J.P.Hopcroft, Rajeev Motwani, J.D.Ullman, Pearson Education., 3rd Edition, 2008,ISBN:81-3172-047-0. |
|  | An Introduction To Formal Languages & Automata, Peter Linz, Narosa Publishing House, 6th Edition, 2007, ISBN: 07-6371-422-4. |

**Continuous Internal Evaluation (CIE); Theory (100 Marks)**

**CIE** is executed by way of Quizzes (Q), Tests (T) and Experiential Learning (EL). A minimum of three quizzes are conducted and each quiz is evaluated for 10 marks adding up to 30 marks. All quizzes are conducted online. Faculty may adopt innovative methods for conducting quizzes effectively. The number of quizzes may be more than three also. The three tests are conducted for 50 marks each and the sum of the marks scored from three tests is reduced to 50. The marks component for experiential learning is 20.

**Total CIE is 30(Q) +50(T) +20(EL) =100 Marks.**

**Semester End Evaluation (SEE); Theory (100 Marks)**

**SEE** for 100 marksis executed by means of an examination. The Question paper for the course contains two parts, Part A and Part B. Part A consists of objective type questions for 20 marks covering the complete syllabus. Part B consists of five main questions, one from each unit for 16 marks adding up to 80 marks. Each main question may have sub questions. The question from Units I, IV and V have no internal choice. Units II and III have internal choice in which both questions cover entire unit having same complexity in terms of COs and Bloom’s taxonomy level.

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| **CO-PO Mapping** | | | | | | | | | | | | |
| **CO/PO** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | **1** | **1** | 2 | **1** | 2 | **-** | **3** | **-** | 2 | 2 | 2 | **1** |
| **CO2** | **-** | **3** | **-** | **-** | **1** | 2 | **3** | **-** | **3** | **2** | **-** | **1** |
| **CO3** | **3** | **3** | **3** | 2 | 2 | **-** | 2 | **-** | **3** | **3** | 2 | **1** |
| **CO4** | **1** | 2 | 2 | **1** | **1** | 2 | **-** | **3** | 2 | 2 | **3** | **1** |

**High-3: Medium-2: Low-1**