# 20CS2204 - FORMAL LANGUAGES AND AUTOMATA THEORY

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| Course Category: |  Program Core | Credits: | 3 |
| Course Type: | Theory | Lecture-Tutorial-Practical: | 3-0-0 |
| Prerequisite: | Knowledge in Discrete Mathematics and logical reasoning | Sessional Evaluation:Univ. Exam Evaluation:Total Marks: | 4060100 |
| Objectives: | * Basic mathematical foundations of computation and various other notions.
* Understand and conduct mathematical proofs for computation and algorithms.
* Familiarity with thinking intuitively for problem solving in related areas of theory in computer science
* Develop a view on the importance of computational theory concepts.
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| Course Outcomes | Upon successful completion of the course, the students will be able to: |
| CO1 | Demonstrate abstract models of computing like DFA and NFA. |
| CO2 | Learn regular languages and are exposed to a overview of the theoretical foundations of computer science. |
| CO3 | Design grammars and recognizers for different formal languages and to prove or disprove theorems in automata theory using its properties. |
| CO4 | Apply Mathematical and formal techniques for solving real time applications using PDA. |
| CO5 | Perceive the power and limitations of a Turing machine. |
| CO6 | Determine the decidability and intractability of computational problems.  |
| Course Content | UNIT-I**Automata:** Introduction to Finite Automata, Structural Representations, Automata and Complexity, Chomsky hierarchy, The Central concepts of Automata Theory-Alphabets, Strings and Languages, Deterministic Finite Automata, Nondeterministic Finite Automata, Finite Automata with Epsilon-Transitions.**Mealy and Moore Models:** Finite Automata With outputs, Procedure for Transforming a Mealy Machine into Moore Machine and Moore Machine to Corresponding Mealy Machine.UNIT-II**Regular Expressions and Languages**: Regular expressions, Finite Automata and Regular Expressions, Algebraic Laws for Regular Expressions.**Properties of Regular Languages**: Proving languages not to be regular, closure properties of regular languages, Decision properties of Regular Languages, Equivalence and Minimization of Automata. UNIT-III**Context Free Grammars and Languages**: Context free grammars, Parse trees, Ambiguity in Grammars and languages, Simplification of Context Free Grammars-Elimination of Useless Symbols, Epsilon-Productions and Unit Productions.**Properties of Context Free Languages**: Normal Forms for context free grammars -Chomsky Normal Form and Greibach Normal Form, Pumping lemma for context free languages, Closure properties of context free languages.UNIT-IV**Push Down Automata**: Definition of Push down automaton, The languages of PDA-Acceptance by final state, Acceptance by empty stack, from empty stack to final state, from final state to empty stack, Equivalence of PDA’s and CFG's, Deterministic PDA, Two Stack Pushdown Automata.UNIT-V**Introduction to Turing Machine**: Turing Machine, Definition, Model, Representation of Turing Machines-Instantaneous Descriptions, Transition Tables and Transition Diagrams, Language of a Turing Machine, Programming Techniques for Turing Machines, Extensions to the Basic Turing Machine, Restricted Turing machines.UNIT-VI**Undecidability**: A Language that is not Recursively Enumerable, an Undecidable problem that is RE, Rice’s theorem and Properties of the RE Languages, Post’s Correspondence problem.**Intractable Problems:** The classes of P and NP. |
| Text Books &ReferencesBooks | **TEXT BOOKS:**1. Introduction to Automata Theory, Languages and Computation, J.E.Hopcroft, R.Motwani and J.D.Ullman, 3rd Edition, Pearson, 2008.

**REFERENCE BOOKS:**1. Formal Language and Automata Theory, K.V.N.Sunitha and N.Kalyani, Pearson, 2015.
2. Introduction to Automata Theory, Formal Languages and Computation, ShyamalenduKandar,Pearson, 2013.
3. Theory of Computation, V.Kulkarni, Oxford University Press, 2013.
4. Theory of Automata, Languages and Computation, Rajendra Kumar, McGraw Hill, 2014
5. Theory of Computer Science-Automata, Languages and Computation, K.L.P.Mishra and N.Chandrasekharan, 3rd Edition, PHI, 2007.
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| E-Resources | 1. <https://nptel.ac.in/courses>
2. <https://freevideolectures.com/university/iitm>
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**CO-PO Mapping:** 3-High Mapping, 2-Moderate Mapping, 1-Low Mapping, - -Not Mapping

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|   | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** |
| **CO1** | 1 | 2 | 3 | 3 | 1 | 1 | - | - | - | - | - | - |
| **CO2** | 3 | 2 | 3 | 1 | 2 | 3 | - | - | - | - | - | - |
| **CO3** | 2 | 1 | 3 | 3 | 3 | 2 | - | - | - | - | - | - |
| **CO4** | 3 | 2 | 3 | 2 | 3 | 3 | - | - | - | - | - | - |
| **CO5** | 3 | 2 | 3 | 2 | 3 | 3 | - | - | - | - | - | - |
| **CO6** | 2 | 3 | 3 | 3 | 2 | 1 | - | - | - | - | - | - |