**CSA13**                          **Theory of Computation**                          **L T P C**
                                                                                      3 0 2 4

**Prerequisite:** UBA04

**Course Objectives**

1. Understand the mathematical preliminaries of automata theory
2. Understand and designing computing models like finite automata, pushdown automata and turing machine for formal languages
3. Identify the type of language, the type of automata that can be designed for the language and the type of grammar that can be represented.
4. Acquire knowledge of the application areas of automata theory
5. Understand the undecidability of problems.

**Course Outcomes**

On successful completion of the course, the student will be able to:

1. Understand the basic mathematical concepts of automata theory and to learn the decidability of problems
2. Formulate Regular Expressions and minimized automata for formal languages
3. Ability to construct context free grammar and Grammar Optimization.
4. Understand the Pushdown Automata and Turing Machine basics for formal languages
5. Ability to analysis the decidability and undecidability problem.
6. Recognize the design principles in the construction of system to recognize a formal language
7. Ability to construct various Grammar to accept different types of input pattern
8. Ability to Design Automata and construct any Grammar based on the skills acquired throughout the course
9. Discuss the technical concepts that revolve around various automata, Grammar and languages

UNIT I        FINITE STATE AUTOMATA

Mathematical Preliminaries- Introduction to formal proof – Additional forms of proof – Inductive proofs – The central concept of Automata Theory- Finite Automata (FA) – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Equivalence of NFA and DFA – Finite Automata with Epsilon transitions – Equivalence of NFA with epsilon transitions and NFA without Epsilon Transitions

UNIT II        REGULAR EXPRESSION

Minimization of DFA - Regular Languages - Regular Expression – Equivalence of finite Automaton and regular expressions - Pumping Lemma for Regular sets – Problems based on Pumping Lemma - Closure Properties of Regular Languages

UNIT III        GRAMMARS AND APPLICATIONS

Grammar Introduction – Types of Grammar - Context Free Grammars and Languages–

Derivations – Parse Trees – Simplification of CFG – Greiback Normal form – Chomsky normal form – Problems related to CNF and GNF – Applications of Context-Free Grammars - Closure Properties of Context Free Languages – Pumping lemma for CFL – Problems based on pumping Lemma

UNIT IV      PUSH DOWN AUTOMATA & TURING MACHINES

Pushdown Automata – Definitions – Moves – Instantaneous descriptions – The Language of a PDA – Equivalence of PDA's and CFG's – Introduction to Turing machines – Programming Techniques for Turing Machine – Storage in Finite Control- Multiple Tracks – Checking off Symbols- Subroutine – Comparison of FA, PDA and TM.

UNIT V       UNDECIDABILITY

Language not recursively enumerable – An undecidable problem That is RE – Undecidable Problems About Turing Machines – Recursive and recursively enumerable languages – Rice's Theorem – Post Correspondence Problem.

TEXT BOOKS

J.E.Hopcroft, R.Motwani and J.D Ullman, ―Introduction to Automata Theory, Languages and Computations, Third Edition, Pearson Education, 2014.

REFERENCES

1. H.R.Lewis and C.H.Papadimitriou, ―Elements of the theory of Computation, Second Edition, Pearson Education/PHI, 2003
2. J.Martin, ―Introduction to Languages and the Theory of Computation‖, Third Edition, TMH, 2003.
3. Bernard M. Moret, - The Theory of Computation, Pearson Education, 2002.