

**Paper name: Formal Language & Automata Theory**

**Code: PCC-CS403**

**Contacts: 3L**

**Credits: 3**

**Module-1: [6 L]**

Introduction: Alphabet, languages and grammars, productions and derivation, Chomsky hierarchy of languages.

**Module-2: [7 L]**

Regular languages and finite automata: Regular expressions and languages, deterministic finite automata (DFA) and equivalence with regular expressions, nondeterministic finite automata (NFA) and equivalence with DFA, regular grammars and equivalence with finite automata, properties of regular languages, pumping lemma for regular languages, minimization of finite automata).

**Module-3: [6L]**

Context-free languages and pushdown automata: Context-free grammars (CFG) and languages (CFL), Chomsky and Greibach normal forms, nondeterministic pushdown automata (PDA) and equivalence with CFG, parse trees, ambiguity in CFG, pumping lemma for context-free languages, deterministic push down automata, closure properties of CFLs.

**Module-4: [6L]**

Context-sensitive languages: Context-sensitive grammars (CSG) and languages, linear bounded automata and equivalence with CSG. Turing machines: The basic model for Turing machines (TM), Turing recognizable(recursively enumerable) and Turing-decidable (recursive) languages and their closure properties, variants of Turing machines, nondeterministic TMs and equivalence with deterministic TMs, unrestricted grammars and equivalence with Turing machines, Tms as enumerators.

**Module-6: [6L]**

Undecidability: Church-Turing thesis, universal Turing machine, the universal and diagonalization languages, reduction between languages and Rices theorem, undecidable problems about languages.

**Pre-requisites: Data Structure & Algorithm (PCCCS301), Discrete Mathematics (PCCCS401)**

**Recommended Books:**

John E. Hopcroft, Rajeev Motwani and Jeffrey D. Ullman, Introduction to Automata Theory, Languages, and Computation, Pearson Education Asia.

Michael Sipser, Introduction to the Theory of Computation, PWS Publishing.

Mishra and Chandrashekar, Theory of Computer Science, PHI.

John Martin, Introduction to Languages and The Theory of Computation, TataMcGraw Hill., PEARSON.