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| **Course Code** | **Course Title** | **Credit Hours** |
| **CS4404** | **Theory of Automata** | **3(3+0)** |

**Prerequisites:** Programming Fundamentals, Discrete Structures, Data Structures and Algorithms

**Course Description:** This course serves as an introduction to the basic theory of Computer Science and formal methods of computation. This course will present the theory of finite automata, as the first step towards learning advanced topics, such as compiler design. It will also enable the student to apply the concepts learned in fundamental courses such as Discrete Mathematics, in a theoretical setting; in particular, the application of proof techniques. The applications of finite automata towards text processing will be discussed. This course will also develop an understanding of computation through Turing Machines.

**Aims and Objectives:** Students successfully completing this course should be able to:

* Understand the working of computer at abstract level.
* Design software and some electronic circuits.
* Understand the basic theory behind computer languages.
* Have a sound background for Translator software.

**Course Contents:** Introduction to Language: Language as a set, string, string terminologies, alphabet, operations on languages (Union, Concatenation, Kleene Closure), Language Representation: Recursive Definition, Regular Expression (Basic Regular Expressions, Complex Regular Expressions using notational short hands), Grammars, Automata Introduction: What is Automata? Types of Automata, Parts of Automata, Determinism, Finite Automata (FA): Definition of FA, Elements of FA, Nondeterministic Finite Automata (NFA), Deterministic Finite Automata (DFA), Working of FA, Regular Expression to NFA conversion, NFA to DFA conversion, Minimization of number of states in a DFA, DFA coding in C language, Kleene’s Theorem: Transition Graph (TG), Generalized Transition Graph (GTG), Statement and Proof of Kleene’s Theorem, Finite Automata With output: Moore Machine, Mealy Machine, Moore=Mealy, Context Free Grammars: Definition, Derivation, Problems in Context Free Grammars (Ambiguity, Left Recursion, Common Prefixes), Methods for removal of these problems, Chomsky Normal Form (CNF), Pushdown Automata (PDA): Definition of PDA, Elements of PDA, Creation of PDA i.e. CFG=FA, Touring Machines: Definition of Turing Machines, Elements of Turing Machines, Creation of Turing Machines, Pumping Lemma.

**Recommended Books**

*1.* Cohan, D. A. (1997). *Introduction to Computer Theory (2nd Ed.)*.

*2.* Kellye, D. (1998). *Automata and Formal Languages: An Introduction (1st Ed.)*. Prentice Hall.

*3.* Spiser, M. (2007). *Theory of Computation (Latest ed.)*. Cengage Learning.