**II/IV B. TECH. FIRST SEMESTER**
**FORMAL LANGUAGE AUTOMATA THEORY (Required)**

**Course Code : CS 3T4** **Credits: 3**
**Lecture: 3 periods/ week** **Internal assessment: 30 Marks**
**Tutorial: 1period/week** **Semester end examination: 70 Marks**

**Prerequisites**: Discrete Mathematics, Regular Languages and Finite Automata & Mathematics for Computation Theory

**Course Objectives:**

1. To understand the fundamental models of computation
2. To determine Chomsky classification of languages.
3. To classify machines by their power to recognize language
4. Understand the concepts of decidability, NP-Completeness and NP Hard Problems

**Course Outcomes:**

At the end of this course student will:

CO1) Analyze and design Finite Automata

CO2) Classify the devices according to their computational power

CO3) Understand the concept of the Formal grammars and languages

CO4) Understand Turing machine concept and the techniques applied in computers

CO5) Understand basic complexity classes like P & NP

**Syllabus:**

**UNIT 1**
**Fundamentals**: Strings, Alphabet, Language, Operations, Chomsky hierarchy of languages
**Finite state machine**: Definitions, finite automation model, acceptance of strings and languages, DFA and NFA, transition diagrams and language recognizers. NFA with ε transitions – Equivalence between NFA with and without ε transitions, NFA to DFA conversion, minimization FSM, equivalence between two FSM's, Output machines- Moore and Mealy machine.

**UNIT 2**

**Regular Languages** : Regular Sets , Regular Expressions , identity Rules, Constructing Finite automata for a given regular expressions, Conversion of Finite automata to regular expressions, Pumping lemma of regular sets , closure properties of regular sets (proofs not required).**Regular Grammars** – right linear and left linear grammars, equivalence between regular grammar and FA.

**UNIT 3**

**Context Free Grammar:** derivation trees, sentential forms, right most and left most derivations of strings, Ambiguity in Context free Grammars, Minimization of Context free grammars, CNF, GNF, Pumping Lemma for Context Free Languages. Enumeration of properties of CFL (proofs omitted).**Push down Automata:** definition, model, acceptance of CFL, Acceptance by final state and acceptance by empty state and its equivalence

**UNIT 4**

Equivalence of CFL and PDA (proofs not required), Introduction to DCFL and DPDA.**Turing Machine:** Definition, model, Design of TM, computable functions, recursively enumerable languages. Church's hypothesis, counter machine, types of Turing Machines (proofs not required)

**UNIT 5**

**Computability Theory**: Decidability of problems, Universal TM, Un decidable problems about Turing Machine – Post's Correspondence Problem - The classes P and NP.

**Learning Resource**

**Text Books**

1. Formal Languages and Automata Theory by Basavarj S. Anami,Karibasappa K.G, WILEY-INDIA
2. H.E.Hopcroft, R.Motwani and J.D Ullman, "Introduction to Automata Theory, Languages and Computations", Second Edition, Pearson Education, 2003.

**References**

1. Theory of Computer Science, Automata languages and computation, 2/e,Mishra,Chandra Shekaran, PHI

2. H.R.Lewis and C.H.Papadimitriou, "Elements of The theory of Computation", Second Edition, Pearson Education/PHI, 2003

3. J.C.Martin, "Introduction to Languages and the Theory of Computation", Third Edition, TMH, 2003.
4. Michael Sipser, "Introduction of the Theory and Computation", Thomson Brokecole, 1997.