MCA 315: Theory of Computation	
Teaching Scheme Lectures: 3 hrs/Week Tutorials: 1 hr/Week Credits: 4	**Examination Scheme** Class Test -12Marks Teachers Assessment - 6Marks Attendance – 12 Marks End Semester Exam – 70 marks

Prerequisite: Sets, Relations, Trees, Graphs, Boolean Algebra etc.

Course Objectives:

1. Introduce concepts in automata theory and theory of computation.
2. Identify different formal language classes and their relationships.
3. Design grammars and recognizers for different formal languages.
4. Prove or disprove theorems in automata theory using its properties.
5. Determine the decidability and intractability of computational problems.

Detailed Syllabus

UNIT I Mathematical preliminaries: sets, relations, functions, graphs, trees, string and their properties, principle of induction, proof by contradiction.
UNIT II **Theory of automata:** Alphabets, Strings and Languages; Automata and Grammars, Deterministic finite Automata (DFA)-Formal Definition, Simplified notation: State transition graph, Transition table, Language of DFA, Nondeterministic finite Automata (NFA), NFA with epsilon transition, Language of NFA, Equivalence of NFA and DFA, Minimization of Finite Automata.
UNIT III **Regular sets and regular grammars:** Regular expression (RE) , Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, Arden Theorem, Non Regular Languages, Pumping Lemma for regular Languages. Application of Pumping Lemma, Closure properties of Regular Languages, Decision properties of Regular Languages, FA with output: Moore and Mealy machine, Equivalence of Moore and Mealy Machine, Applications and Limitation of FA.
UNIT IV **Context free grammar (CFG) and Context Free Languages (CFL):** Definition, Examples, Derivation , Derivation trees, Ambiguity in Grammar, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF, Closure properties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Membership, Pumping lemma for CFLs.

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UNIT V **Push down automata (PDA):** Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG.
UNIT VI **Turing machines (TM):** Basic model, definition and representation, Instantaneous Description, Language acceptance by TM, Variants of Turing Machine, TM as Computer of Integer functions, Universal TM, Church's Thesis, Recursive and recursively enumerable languages, Halting problem, Introduction to Un-decidability, Un-decidable problems about TMs.
Text and Reference Books: 1. Hopcroft, Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education, 2010. 2. K.L.P. Mishra and N.Chandrasekaran, "Theory of Computer Science : Automata, Languages and Computation", PHI,2007.

Course Outcomes:

After completing the course, students will be able to:

1. Acquire a fundamental understanding of the core concepts in automata theory and formal languages.
2. An ability to design grammars and automata (recognizers) for different language classes.
3. An ability to identify formal language classes and prove language membership properties.
4. An ability to prove and disprove theorems establishing key properties of formal languages and automata.
5. Acquire a fundamental understanding of core concepts relating to the theory of computation and computational models including (but not limited to) decidability and intractability.