

<b>Devi Ahilya University, Indore, India Institute of Engineering &amp; Technology</b>			<b>MSc – I Year (Applied Mathematics)</b> with Specialization in Computing & Informatics <b>Semester- II</b>				
<b>Subject Code &amp; Name</b>	<b>Instructions Hours per Week</b>			<b>Credits</b>			
<b>AM2PC3: Theory of Computation</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>L</b>	<b>T</b>	<b>P</b>	<b>Total</b>
	<b>3</b>	<b>1</b>	<b>-</b>	<b>3</b>	<b>1</b>	<b>-</b>	<b>4</b>
<b>Duration of Theory Paper: 3 Hours</b>							

**Objectives:** To familiarize students about theoretical and mathematical aspects of computer science.

**Prerequisite:** Basics of Discrete Maths.

### **COURSE OF CONTENTS**

#### **UNIT I**

**Automata Theory:** Introduction to Finite Automata, Structural Representations, Automata and Complexity, Central Concepts to Automata Theory, Finite Automata: An Informal Picture of FA, DFA, NDFA, NFA, Equivalence of NFA and DFA, FA with  $\epsilon$ -transitions: Eliminating  $\epsilon$ -transitions- Conversion of NFA with  $\epsilon$  to NFA without  $\epsilon$ , Conversion of NFA without  $\epsilon$  to DFA, Conversion of NFA to DFA (direct method), Moore and Mealy machines.

#### **UNIT II**

**Regular Expressions (RE) and Languages:** Regular Expressions – Operators of RE, Building RE, Precedence of operators, Algebraic laws for RE, Arden's Theorem, FA and RE: DFA to RE, RE to DFA (RE to s-NFA & e-NFA to DFA and RE to DFA-direct method), FA limitations, Properties of Regular Languages: pumping lemma for regular languages, closure and decision properties of regular languages, Equivalence and minimization of automata, Lexical analysis and finding patterns in text

#### **UNIT III**

**Context Free Grammars (CFG) and Languages:** Context Free Grammar- Definition, derivations, languages of a grammar, sentential form, Parse Tree, Ambiguity in grammars and languages, Properties of CFL- Normal forms- Chomsky Normal Form and Greibach Normal Form, Eliminating unit productions, useless production, useless symbols, and  $\epsilon$ -productions, Regular Grammar and Finite Automata, FA to RG and RG to FA, Inter-conversion between left linear and right linear regular grammar

#### **UNIT IV**

**Push Down Automata (PDA):** The Language of PDA, CFG to PDA, PDA to CFG, Deterministic Push Down Automata - Regular language and DPDA, DPDA and CFL, DPDA and ambiguous grammar, Non-deterministic Push Down Automata, The pumping lemma for CFL, Closure properties of CFL, Chomsky Hierarchy.

**Turing Machine:** Notation, the language of TM, TM and Halting, Programming techniques to TM, Extensions to basic TM, Comparison between FA, PDA.

#### **UNIT V**

Petri nets and its Applications; Programming Language Semantics; Verification of Programs; Formal and Type Systems; Computational Complexity. Complexity of Computing using HLL programs and Automata models; Formal Semantics of programming Languages; Verification of Programs.

#### **BOOKS RECOMMENDED:**

- [1] Cohen, Introduction to Computer Theory, John Wiley, 1990.
- [2] P Linz, An Introduction to Formal languages and Automata, 3/e, Narosa Pub. 2003.
- [3] J. Martin, Introduction to Languages and the Theory of Computation, 3/e, Tata McGraw Hill, 2005.
- [4] J.Hopcroft and J.D. Ullman, Introduction to Languages, Automata and Computation, Addison Wesley, 1981.
- [5] K L P Mishra and N Chandraskran, Theory of Computer Science, PHI Learning Pvt. Ltd., 2006.