COURSE STRUCTURE

Course Code	**AID3PM04A**				
Course Category	**Program Major**				
Course Title	**Theory of Computation**				
Teaching Scheme	**Lectures**	**Tutorials**	**Laboratory / Practical**	**Project**	**Total**
Weekly load hours	**3**	**--**	**--**	**--**	**3**
Credits	**3**	**--**	**--**	**--**	**3**
Assessment Schema Code	**TT1**				

Prerequisites

Course Objectives:

By participating in and understanding all facets of this Course a student will be able:

1. **Knowledge:**
   i. To study equivalence of regular expressions and Finite Automata.
2. **Skill:**
   i. To demonstrate the concepts of Automata theory from the perspective of formal languages.
3. **Attitude:**
   i. To analyze Context Free Grammar and Pushdown automata.
   ii. To design a Turing machine and to understand computability and complexity theory.

Course Outcomes:

On completion of course, students will be able to:

1. To construct Finite Automata to solve problems in computing.
2. To build regular expressions and understand regular language.
3. To construct context-free grammar and Push Down Automata.
4. To design computational models and classify the problems of decidability

Course Contents:

Unit I INTRODUCTION TO FINITE AUTOMATA

Introduction to Formal language, Basic concepts: Symbol, Alphabet, String, Introduction to Finite Automata, State transition graph, Transition table, Acceptance of a string, Acceptance of a Language, Deterministic finite Automata (DFA)-Formal Definition, Non Deterministic finite Automata (NFA)-Formal Definition, Non Deterministic finite Automata (NFA) with epsilon transition, Equivalence of NFA and DFA, Conversion from NFA to DFA, Conversion from NFA with epsilon transition to DFA, Minimization of Finite Automata. Finite Automata with output: Moore and Mealy machine, Moore machine to Mealy machine conversion, Mealy to Moore machine conversion.

Unit II REGULAR EXPRESSION

Formal definition, Operators of regular expression and their precedence, Identities of Regular Expressions. Equivalence between Regular expressions and DFAs. Construction of Regular Expression of the given Language, Construction of Language from the RE, FA and RE, DFA to RE Using Arden's Theorem, RE to DFA, Closure properties of RLs, Applications of Regular

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Expressions, Pumping Lemma for regular expressions.

Unit III CONTEXT FREE GRAMMAR(CFG) and Pushdown Automata:
Formal definition of Grammar, Chomsky Hierarchy, CFG: Formal definition of CFG, Derivations, Parse Tree, Ambiguity in grammars and languages, Language Specification using CFG, Normal Forms: Chomsky Normal form and Greibach Normal Form, Closure properties of CFL, Applications of CFG. PUSH DOWN AUTOMATA(PDA): Pushdown Automata: Definition, Acceptance of PDA, Designing PDA, Deterministic Pushdown Automata, Nondeterministic Pushdown Automata. PDA to CFG and CFG to PDA conversion.

Unit IV TURING MACHINE
Formal definition of a Turing machine, Church- Turing Hypothesis and intuitive notion of algorithm, Instantaneous Description of TM, Recursive Languages and Recursively Enumerable Languages, Design of Turing machines, Nondeterministic Turing machines. Universal TM, Multitape TM, Multistack TM.

UNIT V BASIC INTRODUCTION TO COMPLEXITY
Concept of Decidability, Un-decidability of Halting Problem. Examples of undecidable problems: Post Correspondence Problem, Introductory ideas on Time Complexity of deterministic and non-deterministic Turing Machines. P and NP, Examples of NP-Complete and NP hard problems. The universal and diagonalization languages, reduction between languages and Rice's theorem, undecidable problems about languages.

Learning Resources:

Text Books:

1. Vivek Kulkarni, Theory of Computation, Oxford University Press, ISBN-13: 978-0-19-808458-7
2. K.L.P Mishra, N. Chandrasekaran, Theory of Computer Science (Automata, Languages and Computation), Prentice Hall India, 2nd Edition.

Reference Books:

1. John C. Martin, Introduction to Language and Theory of Computation, TMH, 3rd Edition, ISBN: 978-0-07-066048-9
2. Michael Sipser, Introduction to the Theory of Computation, CENGAGE Learning, 3rd Edition, ISBN:13:978-81-315-2529-6
3. Daniel Cohen, Introduction to Computer Theory, Wiley India, 2nd Edition, ISBN: 9788126513345
4. Kavi Mahesh, Theory of Computation: A Problem Solving Approach, 1st Edition, Wiley- India, ISBN: 978-81-265-3311-4

Supplementary Reading:

1. Hopcroft Ullman, Introduction to Automata Theory, Languages and Computations, Pearson Education Asia, 2nd Edition, ISBN: 9788131720479

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Web Resources:

1. https://nptel.ac.in/courses/106/104/106104148/
2. https://www.youtube.com/watch?v=uXaWLM6Oc44 https://www.youtube.com/watch?v=-aIRqNnUvEg

Pedagogy:

1. PowerPoint Presentation
2. Active Learning
3. WACOM writing pad
4. White-board / Pen

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