

Branch Name:	Artificial Intelligence & Data Science
Semester/Year:	Semester IV / Second Year
Subject Title:	Formal Language & Automata Theory
Subject Code:	1ET1080402
Pre-requisite:	Discrete Mathematics, Data Structures and Algorithms

Course Objective:

- To Study the basic mathematical concepts and their implementation in Computational models
- Develop a formal notation for strings, languages and machines.
- Design finite automata to accept a set of strings of a language.
- Prove that a given language is regular and apply the closure properties of languages.
- Design context free grammars for context free language and convert them into normal forms.
- Design Pushdown Automata and Turing Machines for context free and higher class languages.
- Design and understand the fundamental concepts of Theory of Computation in the computer field to solve computational problems and also in the field of compiler.

Teaching Scheme (Hours per week)				Evaluation Scheme (Marks)				
Lecture(L)	Tutorial (T)	Practical (P)	Credit	Theory (Marks)		Practical (Marks)		Total (Marks)
				University Assessment	Continuous Assessment	University Assessment	Continuous Assessment	
03	-	-	03	70	30	--	--	100

Subject Contents			
Sr. No	Topic	Total Hours	Weightage (%)
1	Review of Basic Mathematical Concepts: Sets, Functions, relations, languages, Logical statements, Proofs, Mathematical induction, Recursive definitions	05	14
2	Regular Languages and Deterministic Finite Automata: Alphabets, Strings, Language, regular languages, Regular expressions. Finite automata: definition, and construction, union, intersection and complement of regular languages, recursive definition of FA, Minimization of Finite automata, Regular and Non Regular Languages– pumping lemma. FA with output: Moore and Mealy machines - Definition, models, inter-conversion.	09	20
3	Non Deterministic FA and Non Deterministic FA-Λ: NFA: Definition, Recursive definition of NFA, conversion of NFA to FA. NFA- Λ : Definition, Recursive definition, conversion of NFA- Λ to NFA, RE to NFA	05	14

4	Context free grammar (CFG): Definition, construction, Derivation, parse trees, Ambiguous Grammar and Removal of Ambiguity, Simplification of CFG: Eliminating unit productions, useless production, useless symbols, and ϵ -productions, Chomsky Normal Form- CNF (CFG to CNF)	06	18
5	Pushdown Automata and CFL: Definition and Construction of Deterministic PDA and Non Deterministic PDA. Equivalence of PDAs and CFGs, intersection and complements of CFL and Non-CFL	06	18
6	Turing Machine (TM): Definition and Construction of Turing Machines. Languages of TM, computing functions with TM, Church Turing Thesis, Non-deterministic TM, Universal TM, Comparison And Applications of DFA, PDA and TM.	06	12
7	Computable Functions: Partial, total, constant functions, Primitive Recursive Functions, Bounded Minimization, Regular function, Recursive Functions	02	04

Course Outcome:

On completion of the course, student will be able to:

- Develop problem solving abilities using mathematical theories.
- Write a formal notation for strings, languages and machines.
- Understand languages, regular language, context free languages, higherclass languages.
- For a given language determine whether the given language is regular or not.
- Decide and apply different computational method strategies such as FA, NFA, PDA, and Turing Machines to solve the complex problems.
- Determine equivalence of languages accepted by Push Down Automata and languages generated by context free grammars
- Understand the rudiments concept of Compiler

List of Text Books:

1. Introduction To Languages and Theory of Computation – John C. Martin, Tata McGrawHill.

List of Reference Books:

1. An introduction to automata theory and formal languages By Adesh K. Pandey, Publisher: S.K. Kataria & Sons.
2. Introduction to Automata Theory, Languages, and Computation By John Hopcroft, Rajeev Motowani and Jeffrey Ullman.
3. Introduction to the Theory of Computation By Michael Sipser, PWS Publishing.
4. Computation: Finite and Infinite By Marvin L. Minsky Prentice-Hall.

e-Resources:

1. <http://nptel.ac.in/>