CE349: Theory of Computation

Credits and Hours:

Teaching Scheme	Theory	Practical	Tutorial	Total	Credit
Hours/week	3	-	-	3	**3**
Marks	100	-	-	100	

Outline of the Course:

Sr. No.	Title of the unit	Minimum number of hours
1.	Introduction	03
2.	Mathematical Terms and Theory	05
3.	Regular Grammar & Languages, Regular Expression, Finite Automata	14
4.	Context Free Grammar & Languages, Push down Automata	13
5.	Turing Machine, Recursively Enumerable Languages	08
6.	Decidable & Undecidable Problems	02
	Total hours (Theory) :	45
	Total hours (Lab) :	00
	Total hours :	45

Detailed Syllabus:

1.	**Introduction**	**03 Hours**	**6%**
	Alphabet, String, Language, Formal Grammar, Chomsky Hierarchy, Introduction to Automata		
2.	**Mathematical Terms and Theory**	**03 Hours**	**6%**
	Mathematical Inductions, Recursive Definitions		
3.	**Regular Grammar & Languages, Regular Expression, Finite Automata**	**14 Hours**	**32%**
	Regular Language, Regular Expressions, Applications, Chomsky Hierarchy, Finite Automata, Nondeterministic Finite Automata, Kleen's Theorem, Automata with Output (Moore Machine, Mealy Machine), Properties of Regular Languages (Pumping Lemma, Closure Property, Decision Algorithm)		
4.	**Context Free Grammar & Languages, Push down**	**13 Hours**	**30%**

	Automata		
	The Chomsky, Notion of Grammars and Languages Generated by Grammars, CFG, CFL, Regular Language and Regular Grammar, Derivation Tree and Ambiguity, BNF, CNF, GNF, CFL properties (Pumping Lemma, Closure Property, Decision Algorithm), Intersections and Complements of CFL, Non-CFL, Definition, DPDA, NPDA, Equivalence of CFG and PDA		
5.	**Turing Machine, Recursively Enumerable Languages**	**08 Hours**	**18%**
	Definition, Model of Computation, Combining TM, Variations of TM, Non Deterministic TM, Universal TM, Recursively Enumerable and Recursive, Enumerable Languages, Context sensitive languages		
6.	Decidable & Undecidable Problems	**05 Hours**	**08%**
	Tractable and Intractable Problems, Complexity Classes, Tractable and Possibly Intractable Problems, P and NP Completeness, Countability		

Course Outcome (COs):

At the end of the course, the students will be able to

CO1	Apply basic concepts of theory of computation in the computer field in order to solve computational problems.
CO2	Construct algorithms for different problems and argue formally about correctness on different restricted machine models of computation.
CO3	Analyse and design finite automata, pushdown automata and Turing machine for formal languages.
CO4	Apply rigorously formal mathematical methods to prove properties of languages, grammars and automata.
CO5	Identify limitations of some computational models and possible solutions.
CO6	Design context free grammars for formal languages.

Sr. No	**Course Outcomes (Cos)**	**Employability/ Entrepreneurship/ Skill development**
1.	Apply basic concepts of theory of computation in the computer field in order to solve computational problems.	Skill development

2.	Construct algorithms for different problems and argue formally about correctness on different restricted machine models of computation.	Skill development
3.	Analyse and design finite automata, pushdown automata and Turing machine for formal languages.	Employability, Skill development
4.	Apply rigorously formal mathematical methods to prove properties of languages, grammars and automata.	Employability, Skill development
5.	Identify limitations of some computational models and possible solutions.	Employability, Skill development
6.	Design context free grammars for formal languages.	Skill development

Course Articulation Matrix:

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	-	-	-	-	-	-	-	-	-	-	-	3	-
CO2	-	-	3	-	-	-	-	-	-	-	-	-	2	-
CO3	3	2	2	-	-	-	-	-	-	-	-	-	3	-
CO4	2	2	2	-	-	-	-	-	-	-	-	-	1	-
CO5	2	1	1	-	-	-	-	-	-	-	-	-	-	-
CO6	2	-	-	-	-	-	-	-	-	-	-	-	-	-

Enter correlation levels 1, 2 or 3 as defined below:

1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)

If there is no correlation, put "-"

Recommended Study Material:

- **Text books:**
  1. Introduction to Languages and Theory of Computation, John C. Martin, TMH

- **Reference books:**
  1. An introduction to automata theory and formal languages, Adesh K. Pandey, S. K. Kataria & Sons
  2. Introduction to computer theory, Deniel I. Cohen, John Wiley & Sons Inc
  3. Computation: Finite and Infinite, Marvin L. Minsky, Prentice-Hall

4. “An introduction to Formal Languages and Automata”, Peter Linz, 6th edition, Jones & Bartlett Learning
5. “Introduction to the Theory of Computation”, Michael Sipser, 3rd edition, Cengage Learning.

❖ **Web materials:**

1. https://www.youtube.com/watch?v=eqCkkC9A0Q4
2. https://freevideolectures.com/course/3045/theory-of-computation-i
3. https://nptel.ac.in/courses/106/104/106104148/
4. https://nptel.ac.in/courses/106/104/106104028/