

B.E. – CS – R2021 – CBCS

**SEMESTER IV**

U21CS402	THEORY OF COMPUTATION	Category: ESC				
		L	T	P	J	C
		3	0	0	0	3

**PRE-REQUISITES:**

- U21MAG02: Discrete Mathematics

**COURSE OBJECTIVES:**

- To study the concept of finite automata with its types and construction
- To understand the context free grammar for any given language
- To learn Turing machines, decidable and undecidable problems

**COURSE OUTCOMES:**

Upon completion of the course, the student will be able to

**CO1:** Construct finite automata for a given language with its types (Understand)

**CO2:** Prove the equivalence of languages described by finite automata and regular expressions (Apply)

**CO3:** Construct CFG for a given language, simplify and transform to a normal form (Understand)

**CO4:** Design Push Down Automata, convert into CFG and vice-versa (Apply)

**CO5:** Construct Turing machine and prove the undecidability or complexity of a variety of problems (Understand)

**CO-PO MAPPING:**

POs COs	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12	PSO1	PSO2
CO1	3	2	2	1	-	-	-	-	-	2	-	2	2	-
CO2	2	1	-	1	-	-	-	-	-	2	-	1	2	-
CO3	3	2	2	1	-	-	-	-	-	2	-	1	-	-
CO4	3	2	2	1	-	-	-	-	-	2	-	2	-	-
CO5	3	2	2	2	-	-	-	-	-	2	-	2	-	-
CO	3	2	2	1	-	-	-	-	-	2	-	2	2	-
Correlation levels: 1: Slight (Low) 2: Moderate (Medium) 3: Substantial (High)														

**SYLLABUS:**

**UNIT I FUNDAMENTALS OF FINITE AUTOMATA 9**

Introduction – Finite State Systems – Finite Automata – Deterministic Finite Automata (DFA) – Non-deterministic Finite Automata (NFA) – Finite Automata with Epsilon Transitions – Equivalence of NFA and DFA – Equivalence of NFAs with and without Epsilon moves

**UNIT II REGULAR EXPRESSIONS AND LANGUAGES 9**

Regular Expressions – Equivalence of Finite Automata and Regular Expressions – Pumping lemma for regular sets – Closure properties of regular languages – Equivalence and minimization of automata

**UNIT III GRAMMARS**

9

Introduction to Grammar – Types of grammar – Context Free Grammars (CFGs) and Languages (CFLs) – Derivations and languages – Ambiguity – Relationship between derivation and derivation trees – Simplification of CFG – Elimination of useless symbols – Unit productions – Null productions – Normal forms – Greibach Normal Form (GNF) – Chomsky Normal Form (CNF)

**UNIT IV PUSHDOWN AUTOMATA**

9

Pushdown Automata – Definitions – Moves – Instantaneous descriptions – Deterministic pushdown automata – Equivalence of Pushdown automata and CFL – Pumping lemma for CFL – Closure properties of CFL

**UNIT V TURING MACHINE AND UNDECIDABILITY**

9

Turing Machines (TM) – Programming Techniques for TM – Non Recursive Enumerable (RE) Language – Undecidable Problem with RE – Undecidable Problems about TM – Post's Correspondence Problem – The Class P and NP

**Contact Periods:**

Lecture: 45 Periods      Tutorial: – Periods      Practical: – Periods      Project: – Periods  
 Total 45 Periods

**TEXT BOOKS:**

1. J.E.Hopcroft, R.Motwani and J.D Ullman, "Introduction to Automata Theory, Languages and Computations", 6<sup>th</sup> Edition, Pearson Education, 2016.
2. John C Martin, "Introduction to Languages and the Theory of Computation", 3<sup>rd</sup> Edition, Tata McGraw Hill, 2013.

**REFERENCES:**

1. H.R.Lewis and C.H.Papadimitriou, "Elements of the theory of Computation", 2<sup>nd</sup> Edition, Prentice Hall of India, 2010
2. Peter Linz, "An Introduction to Formal Language and Automata", 3<sup>rd</sup> edition, Narosa Publishers, 2011
3. Micheal Sipser, "Introduction to Theory of Computation", 3<sup>rd</sup> Edition, Cengage Publishers, 2014

**EVALUATION PATTERN:**

Continuous Internal Assessments					End Semester Examinations	
Assessment I (100 Marks)		Assessment II (100 Marks)		Total Internal Assessments		
*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test	*Individual Assignment / Case Study / Seminar / Mini Project / MCQ	Written Test			
40	60	40	60			
Total					40	60
					100	

\*Role Play / Group Discussions / Debates / Oral Presentations / Poster Presentations / Technical presentations can also be provided. Course Coordinator can choose any one / two components based on the nature of the course.

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