



# GUJARAT TECHNOLOGICAL UNIVERSITY

**Bachelor of Engineering**

**Subject Code: 3151605**

**Semester – V**

**Subject Name: Formal Language and Automata Theory**

**Type of Course: NA**

**Prerequisite:** Knowledge in mathematics, including a course in discrete mathematics, and in programming.

**Rationale:** To introduce students the basic concepts in theoretical computer science, and the formal relationships among machines, languages and grammars and computational problems. The course should in addition clarify the practical view towards the applications of these ideas in engineering.

**Teaching and Examination Scheme:**

Teaching Scheme			Credits C	Examination Marks				Total Marks
L	T	P		Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
3	0	2	4	70	30	30	20	150

**Content:**

Sr. No.	Content	Hours	% Weightage
1	<b>Introduction to Finite Automata:</b> Introduction to Finite Automata, Central Concepts of Automata Theory, Deterministic Finite Automata (DFA), Nondeterministic Finite Automata (NFA), Finite Automata with Epsilon Transition.	9	19
2	<b>Regular Expressions and Languages:</b> Regular Expressions, Finite Automata and Regular Expressions, Applications of Regular Expressions, Proving Languages Not to Be Regular, Closure Properties of Regular Languages, Equivalence and Minimization of Automata – Pumping Lemma.	6	12
3	<b>Context Free Grammars and Languages Parse Trees:</b> Applications of Context Free Grammars, Ambiguity in Grammars and Languages, Eliminating Useless Symbols, Computing the Generating and Reachable Symbols, Eliminating Epsilon Productions, Eliminating Unit Productions, BackusNaur Form (BNF), Chomsky Normal Form (CNF).	9	19
4	<b>Pushdown Automata, CFL and NCFL:</b> Definition of the Pushdown Automaton (PDA), The Languages of a PDA, Equivalence of PDA's and CFG's, Deterministic Pushdown Automata, The Pumping Lemma for Context Free Languages, Closure Properties of Context Free Languages, Pumping lemma for CFL, Intersections and Complements of CFL, Non-CFL	9	19
5	<b>Turing Machine (TM):</b> Problems That Computers Cannot Solve, The	9	19



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	Turing Machine, Programming Techniques for Turing Machines ,Extensions to the Basic Turing Machine, Restricted Turing Machines , Turing Machines and Computers , Definition of Post’s Correspondence Problem, A Language That Is Not Recursively Enumerable, An Undecidable Problem That Is RE, Context sensitive languages and Chomsky hierarchy, Other Undecidable Problems		
6	<b>Computable Functions:</b> Partial, total, constant functions, Primitive Recursive Functions, Bounded Minimization, Regular function, Recursive Functions	6	12

**Course outcomes:**Students will be able to

Sr. No.	CO Statement	Marks % weightage
1.	<b>Apply</b> the knowledge of automata theory, grammars & regular expressions for solving the problem	25
2.	<b>Analyse</b> the give automata, regular expression & grammar to know the language it represents	20
3.	<b>Design</b> Automata & Grammar for pattern recognition and syntax checking	25
4.	To <b>distinguish</b> between decidability and undecidability of problems	15
5.	<b>Identify</b> limitations of some computational models and possible methods of proving them	15

**Suggested Specification table with Marks (Theory): (For BE only)**

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
<b>10</b>	<b>30</b>	<b>20</b>	<b>20</b>	<b>15</b>	<b>5</b>

**Legends: R: Remembrance; U: Understanding; A: Application, N: Analyze and E: Evaluate C: Create and above Levels (Revised Bloom’s Taxonomy)**

### Text and References

1. Automata Theory, Languages, and Computation By John Hopcroft, Rajeev Motowani, and Jeffrey Ullman
2. Elements of the Theory of Computation, Harry R. Lewis and Christos H. Papadimitriou, Pearson Education Asia.
3. Introduction to the Theory of Computation By Michael Sipser, Thomson Course Technology



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4. Introduction to Languages and Automata Theory By John C Martin, Tata McGraw-Hill
5. An introduction to automata theory and formal languages By Adesh K. Pandey, Publisher: S. K. Kataria & Sons
6. Introduction to computer theory By Deniel I. Cohen , Joh Wiley & Sons, Inc
7. Computation: Finite and Infinite By Marvin L. Minsky Prentice-Hall
8. Compiler Design By Alfred V Aho, Addison Wesley

### List of Practical:

JFLAP is recommended for the design of practicals..

### List of Open Source Software/learning website:

1. [http://en.wikipedia.org/wiki/Theory\\_of\\_computation](http://en.wikipedia.org/wiki/Theory_of_computation)
2. <http://meru.cecs.missouri.edu/courses/cecs341/tc.html>
3. <https://www.coursera.org/courses?query=theory%20of%20computation>
4. [nptel.ac.in/courses/106104028/theory of computation.](http://nptel.ac.in/courses/106104028/theory_of_computation)
5. <https://lagunita.stanford.edu/courses/course-v1:ComputerScience+Automata+SelfPaced/about>