GUJARAT TECHNOLOGICAL UNIVERSITY
Bachelor of Engineering
Subject Code: 3160704
THEORY OF COMPUTATION
6thSEMESTER

Type of course: NA

Prerequisite: Calculus, Data Structures and Algorithms, Set Theory

Rationale: Theory of computation teaches how efficiently problems can be solved on a model of computation. The main thrust is to identify the limitations of the computers through formalizing computation (by introducing several models including Turing Machines) and applying mathematical techniques to the formal models obtained. It is also necessary to learn the ways in which computer can be made to think. Finite state machines can help in natural language processing which is an emerging area.

Teaching and Examination Scheme:

Teaching Scheme			Credits	Examination Marks				Total Marks
L	T	P	C	Theory Marks		Practical Marks		
				ESE (E)	PA (M)	ESE (V)	PA (I)	
4	1	0	5	70	30	0	0	100

Content:

Sr No	Course content	Total Hrs	%Wei ghtage
1	**Review of Mathematical Theory:** Sets, Functions, Logical statements, Proofs, Relations, Languages, Principal of Mathematical Induction, Strong Principle, Recursive Definitions, Structural Induction.	**04**	**10**
2	**Regular Languages and Finite Automata**: Regular Expressions, Regular Languages, Application of Finite Automata, Automata with output - Moore machine & Mealy machine, Finite Automata, Memory requirement in a recognizer, Definitions, union- intersection and complement of regular languages, Non Deterministic Finite Automata, Conversion from NFA to FA, $\wedge$ - Non Deterministic Finite Automata, Conversion of NFA- $\wedge$ to NFA, Kleene's Theorem, Minimization of Finite automata, Regular And Non Regular Languages – pumping lemma.	**12**	**25**
3	**Context free grammar (CFG):** Definitions and Examples, Unions Concatenations And Kleene's of Context free language, Regular Grammar for Regular Language, Derivations and Ambiguity , Unambiguous CFG and Algebraic Expressions, BacosNaur Form (BNF), Normal Form – CNF.	**08**	**15**
4	**Pushdown Automata, CFL And NCFL:** Definitions, Deterministic PDA, Equivalence of CFG and PDA & Conversion, Pumping lemma for CFL, Intersections and Complements of CFL, Non-CFL.	**08**	**15**
5	**Turing Machine (TM):**	**08**	**15**

	TM Definition, Model Of Computation, Turing Machine as Language Acceptor, TM that Compute Partial Function, Church Turning Thesis, Combining TM, Variations Of TM, Non Deterministic TM, Universal TM, Recursively and Enumerable Languages, Context sensitive languages and Chomsky hierarchy.		
6	**Computable Functions:** Partial - Total - Constant Functions, Primitive Recursive Functions, Bounded Mineralization, Regular function, Recursive Functions, Quantification, Minimalization, and μ-Recursive Functions, All Computable Functions Are μ-Recursive	04	10
7	**Undecidability :** A Language That Can't Be Accepted, and a Problem That Can't Be Decided , Non Recursive Enumerable (RE) Language – Undecidable Problem with RE – Undecidable Problems about TM – Undecidable Problems Involving Context-Free Languages, Post's Correspondence Problem, The Class P and NP.	04	10

Suggested Specification table with Marks (Theory):

Distribution of Theory Marks					
R Level	U Level	A Level	N Level	E Level	C Level
15	25	25	5	00	00

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

Note: This specification table shall be treated as a general guideline for students and teachers. The actual distribution of marks in the question paper may vary slightly from above table.

Reference Books:

1. Introduction to Languages and the Theory of Computation, 4th by John Martin, Tata Mc Graw Hill
2. An introduction to automata theory and formal languages By Adesh K. Pandey, Publisher: S.K. Kataria& Sons
3. Introduction to computer theory By Deniel I. Cohen , Joh Wiley & Sons, Inc
4. Computation: Finite and Infinite By Marvin L. Minsky Prentice-Hall
5. Compiler Design By Alfred V Aho, Addison Weslley
6. Introduction to the Theory of Computation By Michael Sipser
7. Automata Theory, Languages, and Computation By John Hopcroft, Rajeev Motowani, and Jeffrey Ullman

Course Outcome:

Sr. No.	CO statement	Marks % weightage
CO-1	Use the concepts and techniques of discrete mathematics for theoretical computer science.	10%

CO-2	Identify different formal languages and their relationship.	25%
CO-3	Classify and construct grammars for different languages and vice-versa.	25%
CO-4	Build finite automata, push down automata and turing machine.	25%
CO-5	Analyze various concepts of undecidability and Computable Function and Discuss analytically and intuitively for problem-solving situation.	15%

List of Open Source Software/learning website:

1. http://en.wikipedia.org/wiki/Theory_of_computation

2. http://meru.cecs.missouri.edu/courses/cecs341/tc.html

3. https://www.geeksforgeeks.org/introduction-of-theory-of-computation/

4. http://www.vssut.ac.in/lecture_notes/lecture1428551440.pdf

5. https://nptel.ac.in/courses/106/104/106104028/