## Year: B. Tech III (Semester VI)

**Subject Name:** Theory of Computation **Subject Code:** BTCO13601
**Type of course:** Professional Core Course
**Prerequisite:** Calculus, Data Structures and Algorithms, Set Theory

**List of Courses where this course will be prerequisite:** Compiler Design, Natural Language Processing.

**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 and applying mathematical techniques to the formal models obtained. It is also necessary to learn the ways in which computers 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 | | | | Theory Marks | | | Practical Marks | | Total |
|---|---|---|---|---|---|---|---|---|---|
| L | T | P | C | TEE | CA1 | CA2 | TEP | CA3 | |
| 3 | 1 | 0 | 4 | 60 | 25 | 15 | 0 | 0 | 100 |

CA1: Continuous Assessment (assignments/projects/open book tests/closed book tests CA2: Sincerity in attending classes/class tests/ timely submissions of assignments/self-learning attitude/solving advanced problems TEE: Term End Examination TEP: Term End Practical Exam (Performance and viva on practical skills learned in course) CA3: Regular submission of Lab work/Quality of work submitted/Active participation in lab sessions/viva on practical skills learned in course

**Contents:**

| Unit No | Contents | Total Hrs |
|---|---|---|
| 1 | **Mathematical Theory Review:** Sets and their notation, Logical statements, Proofs, Functions and their types, Relations and their types, Principle of Mathematical Induction | 03 |
| 2 | **Introduction to languages:** Alphabets, Languages, Types of languages- Regular languages and non-regular languages, Strings, Recursive Definition | 04 |
| 3 | **Finite Automata:** Finite Automata- Introduction and its Applications, Deterministic Finite Automata, Non-Deterministic Finite Automata,∧-Non Deterministic Finite Automata, Conversion of NFA-∧ to NFA, Conversion from NFA to DFA, Conversion of NFA-∧ to DFA, Minimization of Finite automata, Operations on Finite automata- union, concatenation, intersection, complement and difference of regular languages, Finite Automata with output - Moore machine & Mealy machine, Pumping lemma for Regular And Non Regular Languages | 15 |
| 4 | **Context free grammar (CFG):** Introduction, Examples- Languages to CFGs and CFGs to languages, Unions Concatenations and Kleene | 10 |

| | | |
|---|---|---|
| | closure of Context free languages, Derivations, Ambiguity and Unambiguous CFG, Useless - Null - Unit Productions- Introduction and their removal, Chomsky Normal Form, Chomsky hierarchy, Context sensitive languages | |
| 5 | **Pushdown Automata, CFL And NCFL:** Pushdown Automata - Introduction and Definition, Types - Deterministic PDA and Non-Deterministic PDA, Equivalence and Conversion of CFG and PDA, Pumping lemma for CFL and Non-CFL, Intersections and Complements of CFL | 08 |
| 6 | **Turing Machine** - Introduction and Definition, Deterministic TM and Non Deterministic TM, Turing Machine examples for regular and non-regular languages | 05 |

**Suggested Specification table with Marks (Theory/Practical): (For B. Tech. only)**

| Distribution of Theory Marks | | | | | |
|---|---|---|---|---|---|
| **R Level** | **U Level** | **A Level** | **N Level** | **E Level** | **C Level** |
| 15 | 15 | 10 | 05 | 05 | 10 |

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:**

| Sr. No. | Title of book /article | Author(s) | Publisher and details like ISBN | Year of publication / Publication Edition |
|---|---|---|---|---|
| 1 | Introduction to Languages and the Theory of Computation | John Martin | Tata Mc Graw Hill | Latest Edition |
| 2 | An introduction to automata theory and formal languages | Adesh K. Pandey | S.K. Kataria& Sons | |
| 3 | Introduction to computer theory | Deniel I. Cohen | Joh Wiley & Sons, Inc | |

**Course Outcomes (CO):**

| Sr. No. | CO statement | Marks % weightage |
|---|---|---|

| | | |
|---|---|---|
| 1 | Use the concepts and techniques of discrete mathematics for theoretical computer science. | 15% |
| 2 | Identify different formal languages and their relationship. | 35% |
| 3 | Classify and construct grammars for different languages and vice-versa. | 25% |
| 4 | Build finite automata, push down automata and turing machine. | 25% |

**List of Open learning website:**

- NPTEL online course : https://nptel.ac.in/courses/106/104/106104028/
- https://freevideolectures.com/course/3045/theory-of-computation-i

**List of Open Source Software:**

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**FOR LAB SESSIONS:**

**List of Experiments:**

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**Major Equipment Needed:--**