

Theory of Computation

- 1.1 Course Number:CS321
- 1.2 Contact Hours : 3-0-0 Credits: 9
- 1.3 Semester-offered: 3rd Year-Odd
- 1.4 Prerequisite: Discrete Maths
- 1.5 Syllabus Committee Member: Dr. Sushum Biswas, Dr. Daya Sagar Gupta & Dr. Gargi Srivastava

2. **Objective:** The objective of this course is to provide basic definitions that are associated with theory of computation and to give an overview, applications, environment of computation.

3. **Course Content:**

Unit-wise distribution of content and number of lectures

| Unit | Topics | Sub-topic | Lectures |
|------|----------------------|--|----------|
| 1 | Finite Automata | Introduction to finite automata; basic notation and convention; DFA; example of DFAs; computation by DFA and regular operation; introduction to nondeterminism | 5 |
| 2 | Regular Expressions | NFA, definition and examples; equivalence of NFA and DFA, closure properties; regular expressions; algebraic properties, RE to NFA conversion; GNFA to RE conversion | 5 |
| 3 | Regular Languages | More closure properties of regular languages; non-regular languages and pumping lemma; examples of non-regular languages; DFA minimization; introduction to CFGs | 5 |
| 4 | Context Free Grammar | Examples of CFGs, reg subset of CFL; parsetree,, derivation, ambiguity; normal forms, Chomsky normal form; Non-CFLs, pumping lemma; examples of non-CFLs | 5 |
| 5 | Pushdown Automata | Pushdown automata; definition and examples, relation with CFGs; closure properties of CFLs; deterministic context free languages | 5 |
| 6 | Turing Machine | Turing machine; more on Turing machine; non deterministic Turing machine; configuration graphs; closure properties of decidable and Turing recognizable languages | 5 |
| 7 | Decidability | Decidability properties of regular and context free languages; undecidability; more on undecidability; reduction; applications of reduction | 5 |

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| 8 | Computational complexity | Rice's theorem; introduction to computational complexity theory; more on class NP; NP-completeness | 5 |
| | | Total | |

4. Readings

4.1 Textbook:

- Introduction to Automata, Formal Languages and Computation, Peter Linz, Narosa Publishing House.
- Theory of Computer Science, K.L.P. Mishra, PHI, India

4.2 Reference books:

- Computability - B. Jack Copeland, Carl J. Posy, Oron Shagrir The MIT Press

5 Outcome of the Course:

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

1. To use basic concepts of formal languages of finite automata techniques
2. To Design Finite Automata for different Regular Expressions and Languages
3. To Construct context free grammar for various languages
4. To solve various problems of applying normal form techniques, push down automata and Turing Machines
5. To participate in GATE, PGECET and other competitive examinations