Theory of Computation
L-T-P-C : 3-2-0-4

Course Outline:

This fundamental course covers the three main subfields, viz., automata theory dealing with machines and their properties, computability theory dealing mainly with decidability issues, and complexity theory which deals with difficulty levels of solving the so called decidable problems.

Course objectives:

1. To make the student understand basic principles of various machines (automata), formal languages (grammars), and the relation between these two (viz., automata and languages).
2. The notions of algorithm, decidability, complexity, and computability should become clear to the student.
3. Various complexity classes, viz., P, NP, NP-Complete and the relation thereof should become clear to the student.

Syllabus:

Module 1:

Finite automata -- regular languages -- properties of regular languages, closure properties, pumping lemma – regular expressions – conversion between regular expressions and finite automata.

Module 2:

Context-free Grammars and context-free languages -- pushdown automata – Parsing, CYK algorithm -- properties of context free languages – Deterministic pushdown automata – equivalence of CFG and PDA.

Module 3:

Turing Machines -- Church-Turing Thesis -- Variants of Turing machines. Decidability -- reducibility -- undecidable problems. Complexity theory -- the classes of problems: P, NP, NP-complete --Cook–Levin theorem -- intractable problems.

Books:

1. Introduction to Automata Theory, Languages, and Computation -- John E Hopcroft, Rajeev Motwani, and Jeffrey D Ullman, 3rd Edition, Pearson.

2. Introduction to the Theory of Computation -- Michael Sipser, 2nd Edition, Cengage Learning.

3. Introduction to Languages and the Theory of Computation -- John E Martin, 3rd Edition, Tata McGraw Hill.

4. Elements of the Theory of Computation, H. R. Lewis and C.H. Papadimitriou, Prentice Hall Publishers.

Assessment Plan:

Quiz/Assignment	20 Marks
Mid-1	20 Marks
Mid-2	25 Marks
Endsem	35 Marks

LAPTOP/MOBILE USE POLICY : NO LAPTOP OR MOBILE CAN BE USED IN THE CLASS OR EXAMS

CRITERIA FOR GROUP TASKS: NIL

INDUSTRY RELEVANCE AND THRUST AREA TOPICS: THIS IS CORE CS COURSE, RELEVANT TO ANY INDUSTRY WORKING WITH ALGORITHMS. For example,

IBM -- Quantum Computation
Microsoft -- Economics and Computation
Google -- Social Networks, search engines and computation
Forensics -- Crime Analyst, Scene Analysts, etc

ANY OTHER RELEVANT DETAILS: NIL