CP307: THEORY OF COMPUTATION
CREDITS = 4 (L=3, T=1, P=0)

Course Objective:
To lay mathematical foundation of computing through studies of different models of computation, the theory of formal languages and grammars, the notions of algorithm and the decidability of problems

Teaching and Assessment Scheme:

Teaching Scheme			Credits	Marks Distribution				Total Marks
				Theory Marks		Practical Marks		
L	T	P	C	ESE	CE	ESE	CE	
3	1	0	4	70	30	30	20	150

Course Contents:

Unit No.	Topics	Teaching Hours
1	**Preliminaries:** Sets, logic, functions, relations, languages; proof by deduction, proof by contradiction, proof by induction, proving equivalences about sets; recursive definitions.	05
2	**Finite Automata and Regular Languages:** Finite automata as language acceptors, DFA with outputs, determinism and non-determinism, ε-transitions, minimal finite automata, regular languages, regular expressions and finite automata, closure properties of regular languages, pumping lemma for regular languages.	11
3	**Context Free Grammars:** Idea of a grammar, Types of Grammars, Idea of parsing and derivation, regular grammars, context free grammars (CFGs), applications of CFGs, ambiguity in grammars and its removal, simplified and normal forms of grammars.	08

Unit No.	Topics	Teaching Hours
4	**Push Down Automata and Context Free Languages:** Definition of push down automaton (PDA), graphical notations for PDA, languages of a PDA, equivalence of PDA and CFGs, deterministic PDA, pumping lemma for context free languages (CFLs), closure properties of CFLs.	08
5	**Turing Machine and Recursively Enumerable Languages:** Definition of a Turing Machine (TM), constructing TMs, variations of TMs, non-deterministic TMs, universal TMs, Church-Turing thesis, recursively enumerable (RE) and recursive languages, context sensitive languages and Chomsky hierarchy.	08
6	**Undecidability:** Non-recursive languages and undecidable problems, the halting problem, undecidable problems involving TMs, reducibility and its use in proving undecidability.	05
	TOTAL	**45**

List of References:

1. John Martin, "*Introduction to languages and the theory of computation*", McGraw-Hill
2. John E. Hopcroft, Rajeev Motwani, and Jeffrey D. Ullman, "*Introduction to automata theory*, languages, and computation", Pearson Education
3. Michael Sipser, "*Introduction to the theory of computation*", Cengage Learning
4. Daniel Cohen, "*Introduction to computer theory*", John Wiley & Sons, Inc
5. Online video lectures on NPTEL at: http://nptel.ac.in

Course Outcomes (COs):

After successfully completing this course the student will be able to

1. Demonstrate knowledge of the core concepts in automata theory and formal languages
2. Conduct a mathematical proof for establishing key properties of formal languages and automata
3. Design CFG for a given CFL and show parsing and derivation of a given string
4. Determine possible ambiguity of a CFG and design corresponding unambiguous CFG
5. Construct TM for a given recursive language
6. Show fundamental understanding of core concepts relating to undecidability of problems