Course code: Course Title	Course Structure			Pre-Requisite
	L	T	P	Elementary set theory, Relations, Mappings, and some abstract algebra
SE325: Theory of Computation	3	1	0	

Course Objective: To provide knowledge and skills in theoretical foundations of computing that are needed to study and practice computer science.

S. NO	Course Outcomes (CO)
CO1	Understand basic concepts of formal languages, automata, and different types of finite automata.
CO2	Classify programming languages using Chomsky's hierarchy.
CO3	Demonstrate the concepts, representations, and limitations of regular languages.
CO4	Construct context free grammars and evaluate their characteristics.
CO5	Demonstrate deep understanding of pushdown automata and Turing machines to solve computational problems.

S. NO	Contents	Contact Hours
UNIT 1	**Introduction:** Alphabets, Strings and Languages; Automata and Grammars, Deterministic finite Automata (DFA)-Formal Definition, Simplified notation: State transition graph, Transition table, Language of DFA, Nondeterministic finite Automata (NFA), NFA with epsilon transition, Language of NFA, Equivalence of NFA and DFA, Minimization of Finite Automata, Distinguishing one string from other, Myhill-Nerode Theorem.	8
UNIT 2	**Regular expression (RE):** Definition, Operators of regular expression and their precedence, Algebraic laws for Regular expressions, Kleen's Theorem, Regular expression to FA, DFA to Regular expression, Arden Theorem, Non Regular Languages, Pumping Lemma for regular Languages. Application of Pumping Lemma, Closure properties of Regular Languages, Decision properties of Regular Languages, FA with output: Moore and Mealy machine, Equivalence of Moore and Mealy Machine, Applications and Limitation of FA.	8
UNIT 3	**Context free grammar (CFG):** Definition, Examples, Derivation , Derivation trees, Ambiguity in Grammar, Inherent ambiguity, Ambiguous to Unambiguous CFG, Useless symbols, Simplification of CFGs, Normal forms for CFGs: CNF and GNF.	6
UNIT 4	**Context Free Languages (CFL):** Closure properties of CFLs, Decision Properties of CFLs: Emptiness, Finiteness and Membership, Pumping lemma for CFLs.	6
UNIT 5	**Push Down Automata (PDA):** Description and definition, Instantaneous Description, Language of PDA, Acceptance by Final state, Acceptance by empty stack, Deterministic PDA, Equivalence of PDA and CFG, CFG to PDA and PDA to CFG, Two stack PDA.	6

UNIT 6	**Turing machines (TM):** Basic model, definition and representation, Instantaneous Description, Language acceptance by TM, Variants of Turing Machine, TM as Computer of Integer functions, Universal TM, Church's Thesis, Recursive and recursively enumerable languages, Halting problem, Introduction to undecidability, Undecidable problems about TMs. Post correspondence problem (PCP), Modified PCP, Introduction to recursive function theory.	**8**
	TOTAL	**42**

REFERENCES

S.No.	Name of Books/Authors/Publishers	Year of Publication / Reprint
1	John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education India, 3rd Edition.	**2008**
2	K.L.P. Mishra, N. Chandrasekaran, "Theory of Computer Science: Automata, Languages and Computation", Prentice Hall India Learning Private Limited, 3rd Edition.	**2006**
3	John C. Martin, "Introduction to Languages and the Theory of Computation", McGraw-Hill Education, 4th Edition.	**2010**
4	Harry R. Lewis, Christos H. Papadimitriou "Elements of the Theory of Computation", Pearson Education India, 2nd Edition.	**2015**
5	Peter Linz, "An Introduction to Formal Language and Automata", Jones and Bartlett Publishers, Inc, 6th Edition.	**2016**
6	Kamala Krithivasan, R. Rama, "Introduction to Formal Languages, Automata Theory and Computation", Pearson, 1st Edition.	**2009**