Paper Code(s): CIC-206	L	P	C
Paper: Theory of Computation	**4**	**-**	**4**

Marking Scheme:
1. Teachers Continuous Evaluation: 25 marks
2. Term end Theory Examinations: 75 marks

Instructions for paper setter:
1. There should be 9 questions in the term end examinations question paper.
2. The first (1st) question should be compulsory and cover the entire syllabus. This question should be objective, single line answers or short answer type question of total 15 marks.
3. Apart from question 1 which is compulsory, rest of the paper shall consist of 4 units as per the syllabus. Every unit shall have two questions covering the corresponding unit of the syllabus. However, the student shall be asked to attempt only one of the two questions in the unit. Individual questions may contain upto 5 sub-parts / sub-questions. Each Unit shall have a marks weightage of 15.
4. The questions are to be framed keeping in view the learning outcomes of the course / paper. The standard / level of the questions to be asked should be at the level of the prescribed textbook.
5. The requirement of (scientific) calculators / log-tables / data – tables may be specified if required.

Course Objectives :

1.	To understand Automata (Deterministic and Non-Deterministic) and Language Theory
2.	To understand Context Free Grammar (CFG), Parse Trees and Push Down Automata
3.	To introduce the concepts of Turing Machines and Computability Theory
4.	To understand Complexity Theory (NP-completess NP-hardness) and Space complexity

Course Outcomes (CO)

CO 1	Ability to understand the design aspects of “abstract models” of computers like finite automata, pushdown automata, and Turing machines.
CO 2	Ability to comprehend the recognizability (decidability) of grammar (language) with specific characteristics through these abstract models.
CO 3	Ability to decide what makes some problems computationally hard and others easy?
CO 4	A ability to deliberate the problems that can be solved by computers and the ones that cannot?

Course Outcomes (CO) to Programme Outcomes (PO) mapping (scale 1: low, 2: Medium, 3: High)

	PO01	PO02	PO03	PO04	PO05	PO06	PO07	PO08	PO09	PO10	PO11	PO12
CO 1	3	2	2	2	2	-	-	-	2	1	1	3
CO 2	3	2	2	2	2	-	-	-	2	1	1	3
CO 3	3	2	2	2	2	-	-	-	2	1	1	3
CO 4	3	2	2	2	2	-	-	-	2	1	1	3

UNIT – I

Automata and Language Theory: Chomsky Classification, Finite Automata, Deterministic Finite Automata (DFA), Non-Deterministic Finite Automata (NFA), Regular Expressions, Equivalence of DFAs, NFAs and Regular Expressions, Closure properties of Regular grammar, Non-Regular Languages, Pumping Lemma.

UNIT – II

Context Free Languages: Context Free Grammar (CFG), Parse Trees, Push Down Automata (deterministic and non-deterministic) (PDA), Equivalence of CFGs and PDAs, Closure properties of CFLs, Pumping Lemma, Parsing, LL(K) grammar.

UNIT – III

Turing Machines and Computability Theory: Definition, design and extensions of Turing Machine, Equivalence of various Turing Machine Formalisms, Church – Turing Thesis, Decidability, Halting Problem, Reducibility and its use in proving undecidability. Rices theorem. Undecidability of Posts correspondence problem., Recursion

Theorem.

UNIT – IV

Complexity Theory: The class P as consensus class of tractable sets. Classes NP, co-NP. Polynomial time reductions. NP-completess, NP-hardness. Cook- Levin theorem (With proof). Space complexity, PSPACE and NPSPACE complexity classes, Savitch theorem (With proof). Probabilistic computation, BPP class. Interactive proof systems and IP class. relativized computation and oracles.

Textbook(s):

1. Sipser, Michael. Introduction to the Theory of Computation, Cengage Learning, 2012.
2. J. Hopcroft, R. Motwani, and J. Ullman, Introduction to Automata Theory, Language and Computation, Pearson, 2nd Ed, 2006.

References:

1. Peter Linz, An Introduction to Formal Languages and Automata, 6th edition, Viva Books, 2017
1. Maxim Mozgovoy, Algorithms, Languages, Automata, and Compilers, Jones and Bartlett, 2010.
2. D. Cohen, Introduction to Computer Theory, Wiley, N. York, 2nd Ed, 1996.
3. J. C. Martin, Introduction to Languages and the Theory of Computation, TMH, 2nd Ed. 2003.
4. K. L. Mishra and N. Chandrasekharan, Theory of Computer Science: Automata, Languages and Computation, PHI, 2006.
5. Anne Benoit, Yves Robert, Frédéric Vivien, A Guide to Algorithm Design: Paradigms, Methods, and Complexity Analysis, CRC Press, 2013.