AMITY UNIVERSITY
MADHYA PRADESH
Established vide Government of Madhya Pradesh Act No. 27 of 2010

Syllabus

Programme Name: B. Tech. (CSE)		**Session: 2023-27**
Course Code: CSE501	**Course Name:** Theory of Computation	**Semester:** V

Credits (Total)	**L**	**T**	**P**	**Marks (Internal/External**		**Contact Hours(per week)**	**Independent Study Hour (perweek)**	**Section (Group)**
3	3	0	0	30	70	3	3	
UG level						Basic and applied	**Student specific course outcome**	Higher Education Placement Research

Course Objective:

Students will be able to understand the formal mathematical models of computation along with their relationshipswith formal languages. In particular, they will learn regular languages and context free languages which are crucial to understand how compilers and programming languages are built. Also, students will learn that not all problems are solvable by computers, and some problems do not admit efficient algorithms. Throughout this course, students will strengthen their rigorous mathematical reasoning skills.

Course outcomes: After completion of course, the student will be able to:

CO-1	Students will demonstrate knowledge of basic mathematical models of computation and describe how they relate to formal languages
CO-2	Students will understand that there are limitations on what computers can do and learn examples of unsolvable problems.
CO-3	Students will learn that certain problems do not admit efficient algorithms and identify such problems.
CO-4	To explain important notions in computing like nondeterminism, reductions and resource boundedness.

Teaching Pedagogy:

T1	Classroom teaching (white board), Power Point Presentations, Interactive lectures, Inquiry based teaching
T2	Assignments, Flip Class/ Seminars, Quiz, Oral Viva-voce examination

Assessment Tools

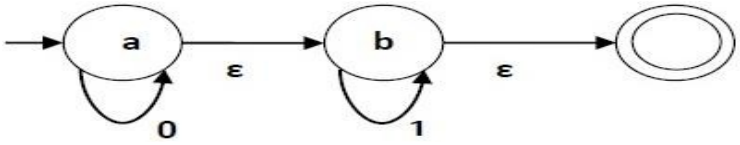
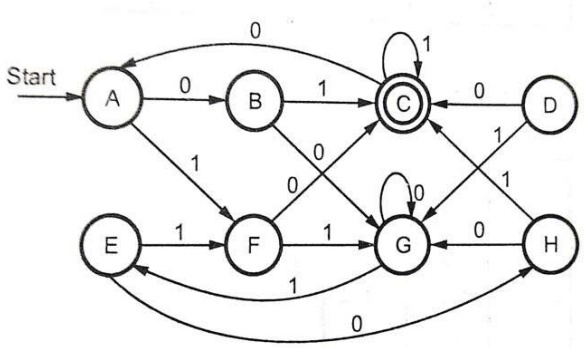
AT1-1	Quiz

AT1-2	Activity Based Learning
AT1-3	Midterm Exams
AT1-4	Flip Class
AT1-5	Seminar Presentation
AT1-6	Assignments
AT1-7	Poster
AT1-8	Oral Viva-voce examination

Prerequisites: Discrete Mathematics should have been completed. It is also desirable (not mandatory) that thestudents have done/are doing in parallel the Design and Analysis of Algorithms course.

Module wise contents details	**Assessment tools**
Module I: Finite Automata and Regular Languages: (13 Hours) Introduction- Basic Mathematical Notation and techniques- Finite State systems – Basic Definitions – Finite Automaton – DFA & NDFA – Finite Automaton with €-moves – Regular Languages- Regular Expression – Equivalence of NFA and DFA – Equivalence of NDFA‟s with and without €-moves – Equivalence of finite Automatonand regular expressions –Minimization of DFA- – Pumping Lemma for Regular sets – Problems based on Pumping Lemma.	Quiz Mid-term Exam Assignment
Module II: Grammars: (11 Hours) Grammar Introduction– Types of Grammar – Context Free Grammars and Languages– Derivations and Languages – Ambiguity- Relationship between derivation and derivation trees – Simplification of CFG – Elimination of Useless symbols – Unit productions – Null productions – Greibach Normal form – Chomsky normal form – Problems related to CNF and GNF. Chomsky hierarchy of languages.	Mid-Term Quiz Assignment
Module III: Pushdown Automata (7 Hours) Pushdown Automata- Definitions – Moves – Instantaneous descriptions – Deterministic pushdown automata – Equivalence of Pushdown automata and CFL – pumping lemma for CFL – problems based on pumping Lemma. Linear Bounded Automata (LBA).	Mid-Term Oral Viva-voce examination Seminar Presentation
Module IV: Turing Machines: (7 Hours) The Turing Machine Model, Language acceptability of Turing Machine, Design of TM, Variation of TM, Universal TM, Church's Machine. Turing machine halting Problem, Post correspondence problems (PCP) and Modified Post correspondence problems	Quiz Assignment Industrial Visit Report Seminar Presentation
Module V: Unsolvable Problems and Computable Functions: (7 Hours) Unsolvable Problems and Computable Functions – Primitive recursive functions –Recursive and recursively enumerable languages. Tractable and Intractable problems: P and NP Class problems, NP completeness, Satisfiability problem.	Quiz Assignment Industrial Visit Report Poster Oral Viva-voce examination

Additional Learning:

List of Assignments	Q1. Design a complete DFA which accept all the strings over ∑ = {a, b} where |w|<=3. Q2. Construct a NDFA for L= {strings where 2rd and 4th symbol from RHS is 'c'} over ∑ = {c, d}. Q3. Design a mealy machine to find 2's complement of given binary number and convert it into equivalent moore machine. Q4. Convert the following RA into its equivalent DFA − 1 (0 + 1)* 0. Q5. Obtain an equivalent automata without null(^) move for the finite automata with null(^) moves given below  Q6. Design a PDA for the language L= { 0^n1^n} where n >=1. Q7. Write need of minimization of finite automata. Minimize the DFA given below using Myhill Nerode theorem.  Q8. Design Turing machine for language L= {0n1n| n>=1}. Take n=3 for the demonstration of Turing machine. Q9. Explain primitive recursive function with the help of example. Q10.Symbolically define PDA. How is it differ from DFA. Design a PDA to acceptthe following languages: i) L= { WWR | W ϵ (0,1)*} ii) L ={ w ϵ (a,b)* | w has equal number of a's and b's}
Suggested reading:	**Text:** • Hopcroft and Ullman, "Introduction to Automata Theory, languages and computation", Addision Wesley. • "An introduction to formal languages and Automata (2nd ed)" by Peter Linz, D. C. Health and Company. **References:** • "Introduction to theory of computation (2nd Ed)" by Michael sipser. • Mishra & Chandrashekharan, "Theory of Computer Sciences", PHI. • Zavi Kohavi, "Switching and finite Automata Theory " • Kohan, "Theory of Computer Sciences". • Korral, "Theory of Computer Sciences".

Suggested e- resources (Websites/e-books)	Lecture Notes | Theory of Computation | Mathematics | MIT OpenCourseWare CS331: Theory of Computation (iitb.ac.in)

Assessment Plan:

Component of Evaluation	**Description**	**Code**	**Weightage %**
Continuous Internal Evaluation	Mid Term	CT	15%
	Seminar/Viva-Voce/Quiz/Home Assignment	S/V/Q/HA	10%
Attendance	A minimum of 75% Attendance is required to be maintained by astudent to be qualified for taking the End Semester examination. The dispensation of 25% includes all types of leaves. including medical leaves.	A	5%
End Semester Examination	End Semester Examination	ESE	70%
Total			**100%**

Abbreviations: CT: Class Test, HA: Home Assignment, S/V/Q: Seminar/Viva/Quiz, ESE: End SemesterExamination; A: Attendance

Course Articulation Matrix (Mapping of COs with POs)

Course Outcomes	**Correlation with POs**												**Correlation with PSOs**		
	PO1	**PO2**	**PO3**	**PO4**	**PO5**	**PO6**	**PO7**	**PO8**	**PO9**	**PO10**	**PO11**	**PO12**	**PSO1**	**PSO2**	**PSO3**
CO1	3	3	1	3	1				2		2	1			
CO2	3	2	2	2	2				2		1	1			
CO3	3	2	2	2	2				3		3	1			
CO4	3	3	2	3	2				1		2	1			