Formal Languages Automata Theory

Course Code	22CS52	Course type	IPCC	Credits L-T-P	3 - 0 - 1
Hours/week: L - T- P	3 - 0 – 2			Total credits	4
Total Contact Hours	L = 40 Hrs; T = 0 Hrs; P = 20 Hrs Total = 60 Hrs			CIE Marks	100
Flipped Classes content	10 Hours			SEE Marks	100

Course learning objectives	
1.	To study abstract computing machines, Language representation techniques and finite state machines to realize formal language.
2.	To Employ regular expressions and properties to solve problems in computing.
3.	To Design Grammars and Recognizers for different formal languages
4.	To Understand Push Down Automata and Turing theory and its significance.
5.	To Demonstrate Lex and YACC tools.

Prerequisite: Basic knowledge of problem solving and Discrete mathematics

Unit – I	Contact Hours = 8 Hours
Introduction to Finite Automata: Introduction to Finite Automata, Structural Representation. The central concepts of Automata theory – Alphabet, Strings & Languages. Deterministic Finite Automata (DFA), Non -Deterministic and Equivalence of NFA and DFA, FA with Epsilon (ε) transitions.	

Unit – II	Contact Hours = 8 Hours
Regular Expressions and languages: Regular Expressions, Finite Automata and Regular Expressions, Properties of Regular Languages (RL): Proving Languages not to be Regular. Equivalence and Minimization of Automata. Applications of Regular Expressions.	

Unit – III	Contact Hours = 8 Hours
Context -Free Grammars (CFG) and Languages (CFL): Context - Free Grammars, Parse Trees, Applications of Context - Free Grammars, Ambiguity in Grammars and Languages. Normal forms for Context Free Grammar.	

Unit – IV	Contact Hours = 8 Hours
Pushdown Automata (PDA): Definition of Pushdown Automata, The languages of a PDA: Acceptance by Final state & Empty stack. Introduction to Turing Machines (TM): Turing Machine model: Definition of Turing Machine, Transition Function, Instantaneous Description & Moves, Programming a Turing Machine, Language recognition by Turing Machine.	

Unit – V		Contact Hours = 8 Hours
LEX and YACC Tools: The Simplest Lex Program, Recognizing Words with Lex. Grammars: Parser-Lexer communication, A Yacc Parser, Rules section. Running Lex and Yacc and examples. Using Lex: Regular Expressions and examples. Using Yacc: Shift reduce parsing, Arithmetic Expressions Validity and Evaluation.		

Flipped Classroom Details

Unit No.	I	II	III	IV	V
No. for Flipped Classroom Sessions	2	2	2	2	2

List of Experiments

Unit No.	No. of Experiments	Topic(s) related to Experiment
I.	-	
II.	3	Programs on regular expressions using Lex tool
III.	3	Programs on Context Free Grammars using YACC tool
V.	2	Programs to check validity and evaluation of arithmetic expression using YACC tool

Unit No.	Self-Study Topics
I.	Applications of Automata Theory.
II.	Properties of Regular Languages
III.	Normal form of Context Free Grammars (GNF)
IV.	Lexical and Syntax Analysis phases of Compiler Design

Books

	Text Books:
1.	John E. Hopcroft, Rajeev Motwani, Jeffrey D. Ullman, "Introduction to Automata Theory, Languages and Computation", Pearson Education, 3/E, 2013
2.	John R. Levine and Tony Mason and Doug Brown, Lex and Yacc, "UNIX programming tools", 2/E, 1992.
3.	S. P. Euguene Xavier "Theory of Automata, Formal Languages and Computation ", 5/ E 2008.
	Reference Books:
1.	Alfred V Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, "Compilers Principles, Techniques and Tools", Pearson Education, 2 / E,2008.
2.	Peter Linz, "An Introduction to Formal Languages and Automata",Narosa Publishing House, 5/E, 2011.
	E-resources (NPTEL/SWAYAM/ Any Other)
1.	https://nptel.ac.in/courses/106105196

Course delivery methods		Assessment methods	
1.	Chalk and Talk	1.	IA tests
2.	PPT and Videos	2.	Open Assignment (OA)/ Lab Project/ Industry assignment/Certification/ Course project
3.	Flipped Classes	3.	Lab Test
4.	Practice session/Demonstrations in Labs	4.	Semester End Examination
5.	Virtual Labs (if present)		

Course Outcome (COs)

Learning Levels:

Re **- Remember**; Un - **Understand;** Ap - **Apply**; An - **Analysis**; Ev - **Evaluate**; Cr - **Create**

At the end of the course, the student will be able to		Learning Level	PO(s)	PSO(s)
1.	Acquire fundamental understanding of the core concepts in automata theory , regular expressions, CFG, PDA, Turing machines .	Un	1,2	1,3
2.	Design Finite state machines and Regular Expressions for the given pattern.	Ap	1,2,3,12	1,3
3.	Design Grammars for different language classes and become knowledgeable about restricted models of Computation (Regular, Context Free)	Ap	1,2,3,12	1,3
4.	Design and Analysis of PDA, Turing Machine for the given problem description.	An	1,2,3,12	1,3
5.	Design programs to implement lexical analyzer & parsers using LEX and YACC tools.	Ap	1,2,3,5,12	1,2,3

Scheme of Continuous Internal Evaluation (CIE):

For integrated courses, a lab test also will be conducted at the end of the semester. The lab test (COMPULSORY) will be part of the CIE. **No SEE for Lab**.

THEORY (60 marks)		LAB (40 marks)		Total
IA test 1	IA test 2	Conduction	Lab test	
30 marks	30 marks	10 marks	30 marks	100 marks
IA Test: 1. No objective part in IA question paper 2. All questions descriptive				
-Certification earned by passing the standard Online MOOCs course (of at least 8 hours defined by BOS) can be considered as a Course activity/Assignment and awarded maximum of 10 marks.				
Conduct of Lab: 1. Conducting the experiment and journal: 5 marks 2. Calculations, results, graph, conclusion and Outcome: 5 marks				
Lab test: (Batch wise with 15 students/batch) 1. Test will be conducted at the end of the semester 2. Time table, Batch details and examiners will be declared by Exam section 3. Conducting the experiment and writing report: 5 marks 4. Calculations, results, graph and conclusion: 15 marks 5. Viva voce: 10 marks				
Eligibility for SEE: 1. 40% and above (24 marks and above) in theory component (No change) 2. Student should score minimum 40% of 30 marks (i.e. 12 marks) in Lab test & should score 40% of 40 marks (i.e. 16 marks) in Total. 3. Lab test is COMPULSORY 4. Not eligible in any one of the two components will make the student Not Eligible for SEE				

	Scheme of Semester End Examination (SEE):
1.	It will be conducted for 100 marks of 3 hours duration.
2.	Minimum marks required in SEE to pass: Score should be ≥35 &, however overall score of CIE+SEE should be ≥40%.
3.	Question paper contains three parts A, B and C. Students have to answer 1. From Part A answer any 5 out of 7 questions, each Question Carries 6 Marks. 2. From Part B answer 5 out of 10 questions choosing any one full question from each unit, each Question Carries 10 Marks. 3. From Part C answer 1 out of 2 questions, each Question Carries 20 Marks.

	CO-PO Mapping (planned)												CO-PSO Mapping (planned)		
CO	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO 12	PSO1	PSO2	PSO3
1	✔	✔											✔		✔
2	✔	✔	✔									✔	✔		✔
3	✔	✔	✔									✔	✔		✔
4	✔	✔	✔									✔	✔		✔
5	✔	✔	✔		✔							✔	✔	✔	✔
Tick mark the CO, PO and PSO mapping															

Sl No	Skill & competence enhanced after undergoing the course	Applicable Industry Sectors & domains	Job roles students can take up after undergoing the course
1	Compiler Design phases	Core Companies, Networking companies	Software Designer