Course Title: Automata Theory And Computability			**Course Code:** 18CS54
Semester: V-A/B/C	**Academic Year:**2021 – 2022	**Total hrs.:**40	**Hrs./Week:** 03
Int. Exam Hrs.: 1hr 30min	**CIE :Max. Marks:** 40		
Ext. Exam Hrs.: 03	**SEE: Max.Marks:**60		
Lesson Plan Author / Desgn. / Dept.: Dr. Gopalakrishna M T/ Chandrashekar D K/ Professor / Asst. Professor / CSE			

Course Objectives:

- Introduce core concepts in Automata and Theory of Computation.
- Identify different Formal language Classes and their Relationships.
- Design Grammars and Recognizers for different formal languages.
- Prove or disprove theorems in automata theory using their properties.
- Determine the decidability and intractability of Computational problems.

Course Outcomes:

CO1: Acquire fundamental understanding of the core concepts in automata theory and Theory of Computation.
CO2: Learn how to translate between different models of Computation (e.g., Deterministic and Non-deterministic and Software models).
CO3: Design Grammars and Automata (recognizers) for different language classes and become knowledgeable about restricted models of Computation (Regular, Context Free) and their relative powers.
CO4: Develop skills in formal reasoning and reduction of a problem to a formal model, with an emphasis on semantic precision and conciseness.
CO5: Classify a problem with respect to different models of Computation.

Syllabus

Course Title: Automata Theory And Computability **Course code: 18CS54**

Module I	**Teaching Hours**
Title: Why study the Theory of Computation, Languages and Strings: Strings, Languages. A Language Hierarchy, Computation, Finite State Machines (FSM): Deterministic FSM, Regular languages, Designing FSM, Nondeterministic FSMs, From FSMs to Operational Systems, Simulators for FSMs, Minimizing FSMs, Canonical form of Regular languages, Finite State Transducers, Bidirectional Transducers.	08
Blooms Taxonomy:L1 – Remembering, L2 – Understanding, L3 – Applying	

Module II	**Teaching Hours**
Title: Regular Expressions (RE): what is a RE?, Kleene's theorem, Applications of REs, Manipulating and Simplifying REs. Regular Grammars: Definition, Regular Grammars and Regular languages. Regular Languages (RL) and No regular Languages: How many RLs, To show that a language is regular, Closure properties of RLs, to show some languages are not RLs	08
Blooms Taxonomy:L1 – Remembering, L2 – Understanding, L3 – Applying	

Module III	**Teaching Hours**
Title: Context-Free Grammars(CFG): Introduction to Rewrite Systems and Grammars, CFGs and languages, designing CFGs, simplifying CFGs, proving that a Grammar is correct, Derivation and Parse trees, Ambiguity, Normal Forms. Pushdown Automata (PDA): Definition of non-deterministic PDA, Deterministic and Non-deterministic PDAs, Non-determinism and Halting, alternative equivalent definitions of a PDA, alternatives that are not equivalent to PDA.	08
Blooms Taxonomy:L1 – Remembering, L2 – Understanding, L3 – Applying	

Module IV	**Teaching Hours**
Title: Context-Free and Non-Context-Free Languages: Where do the Context-Free Languages(CFL) fit, showing a language is context-free, Pumping theorem for CFL, Important closure properties of CFLs, Deterministic CFLs. Algorithms and Decision Procedures for CFLs: Decidable questions, Un-decidable questions. Turing Machine: Turing machine model, Representation, Language acceptability by TM, design of TM, Techniques for TM construction.	08
Blooms Taxonomy:L2 – Understanding, L3 – Applying, L4 – Analysing,L5 – Evaluating.	

Module/Unit: V	**Teaching Hours**
Title: Variants of Turing Machines (TM), The model of Linear Bounded automata: Decidability: Definition of an algorithm, decidability, decidable languages, Undecidable languages, halting problem of TM, Post correspondence problem. Complexity: Growth rate of functions, the classes of P and NP, Quantum Computation: quantum computers, Church-Turing thesis.	08

Blooms Taxonomy:L2 – Understanding, L3 – Applying, L4 – Analyzing

Module / Unit Wise Plan

DAYS	UNIT No. & Title	SUB TOPICS	Planned Date	
1.	**Module I**: Why study the Theory of Computation:	Review of Mathematical Theory: The Theory of Computation, Languages and Strings: A Language Hierarchy		04-10-2021
2.		A Language Hierarchy Finite State Machines (FSM): Deterministic FSM		09-10-2021
3.		Finite State Machines (FSM): Deterministic FSM		11-10-2021
4.		Designing FSM, Regular languages		13-10-2021
5.		Nondeterministic FSMs,		16-10-2021
6.		Students will be able to understand the concepts of From FSMs to Operational Systems,		18-10-2021
7.		Students will be able to understand the concepts of Minimizing FSMs Simulators for FSMs Canonical form of Regular languages,		23-10-2021
8.		Students will be able to understand the concepts of Finite State Transducers, Bidirectional Transducers		25-10-2021
9.	**Module** II : Regular Expressions (RE)	Regular Expressions (RE): what is a RE? Kleene's theorem, Applications of REs,		27-10-2021
10.		Manipulating and Simplifying REs. Regular Grammars: Definition,		30-10-2021
11.		Regular Grammars and Regular languages		06-11-2021
12.		Regular Languages (RL) and Non regular Languages		08-11-2021
13.		Regular Languages (RL) and How many RLs,		10-11-2021
14.		To show that a language is regular		13-11-2021
15.		Closure properties of RLs,		15-11-2021
16.		To show some languages are not RLs.		17-11-2021
17.	**Module** III: Context-Free Grammars(CFG)	Introduction to Rewrite Systems and Grammars, CFGs and languages,		20-11-2021
18.		designing CFGs, Simplifying CFGs, proving that a Grammar is context-free.		24-11-2021
19.		Derivation and Parse trees, Ambiguity, Normal Forms.		27-11-2021
20.		Pushdown Automata (PDA): Definition of non-deterministic PDA,		29-11-2021
21.		Deterministic and Non-deterministic PDAs,		01-12-2021
22.		Non-determinism and Halting		04-12-2021

23.		Alternative equivalent definitions of a PDA,		06-12-2021
24.		Alternatives that is not equivalent to PDA.		08-12-2021
25.	**Module** IV: Context-Free and Non-Context-Free Languages	Important closure properties of CFLs,		11-12-2021
26.		Deterministic CFLs. Algorithms and Decision Procedures for CFLs:		13-12-2021
27.		Decidable questions, Un-decidable questions.		15-12-2021
28.		Turing Machine: Turing machine model		18-12-2021
29.		Representation, Language acceptability by TM,		20-12-2021
30.		Design of TM, Techniques for TM construction		22-12-2021
31.		Context-Free and Non-Context-Free Languages		27-12-2021
32.		Where do the Context-Free Languages(CFL) fit		29-12-2021
33.		Showing a language is context-free,		01-01-2021
34.		Pumping theorem for CFL, The model of Linear Bounded automata		03-01-2021
35.	**Module** V: The model of Linear Bounded automata	Decidability: Definition of an algorithm		05-01-2021
36.		Decidability, decidable languages, Undecidable languages ,		08-01-2021
37.		Halting problem of TM, Post correspondence problem		10-01-2021
38.		Complexity: Growth rate of functions, The classes of P and NP,		12-01-2021
39.		Quantum Computation: quantum computers		15-0-2021
40.		Church-Turing thesis.		17-012021

Reference / Text Book Details

Sl. No.	Title of Book	Author	Publication	Edition
1	Automata, Computability and Complexity	Elaine Rich	Pearson Education, 2012/2013	1st Edition
2	Theory of Computer Science	K L P Mishra, N Chandrasekaran	PhI, 2012	3rd Edition
3	Introduction to Automata Theory, Languages, and Computation	John E Hopcroft, Rajeev Motwani, Jeffery D Ullman	Pearson Education, 2013.	3rd Edition
4	Introduction to the Theory of Computation	Michael Sipser	Cengage learning,2013	3rd Edition

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