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| --- | --- | --- | --- | --- | --- |
|  | **Formal Languages and Automata Theory** | L | T | P | C |
| **Version 1.0** |  | 3 | 0 | 0 | 3 |
| **Pre-requisites/Exposure** | Engineering Mathematics | | | | |
| **Co-requisites** | -- | | | | |

**Course Objectives**

1. To design the finite automata and pushdown automata.
2. To design the grammar for context free grammar
3. To identify different formal language classes and their relationships

**Course Outcomes**

On completion of this course, the students will be able to

1. Comprehend regular grammar and regular expressions using Finite-State Automata.
2. Demonstrate relationship between automata and regular sets.
3. Construct Pushdown Automata and Turing Machines to accept input based on appropriate grammar.
4. Analyze problems for solvability and decidability.

**Catalog Description**

This course presents abstract models of computers (finite automata, push-down automata and Turing machines) and the language classes they recognize or generate (regular, context-free and recursively enumerable). Applications of these models to complete design, algorithms and complexity theory are also the part of the course.

**Course Content**

**UNIT I:**   **6 lecture hours**

Introduction to Defining Language, Kleene Closures, Formal language  theory , Arithmetic Expressions, Defining Grammar, Chomsky Hierarchy, Transition Graph, Generalized Transition Graph.

**UNIT II:**  **8 lecture hours**

Automata Theory, Nondeterministic Finite Automata (NFA), Deterministic Finite Automata (DFA), Construction of DFA from NFA and Optimization, FA with Output: Moore Machine, Mealy Machine and Equivalence, Applications and Limitation of FA. Arden Theorem, Pumping Lemma for regular expressions, Myhill-Nerode Theorem.

**UNIT III:**   **8 lecture hours**

Context Free Grammar: Ambiguity, Simplification of CFGs, Normal Forms for CFGs, Pumping Lemma for CFLs, Decidability of CFGs, Ambiguous to Unambiguous CFG

**UNIT IV:** **4 lecture hours**

Push Down Automata (PDA), Description and Definition, Working of PDA, Acceptance of a String by PDA, PDA and CFG, Introduction to auxiliary PDA and Two stack PDA. Determinism and nondeterminism, Pumping Lemma.

**UNIT V:**  **5 lecture hours**

TM Basic Model, Definition and representation, Language Acceptance by TM, TM and type 0 grammar, Halting Problem of TM, Modifications in TM, Universal TM. Language accepted by a TM, Role of TM, Design of TM

**UNIT VI:**  **5 lecture hours**

Properties of Recursive and Recursively Enumerable Languages, Unsolvable Decision Problem, Empty and non-empty language, Rice theorem, Undecidability of Post Correspondence Problem, Church's Thesis, halting problem, Recursive Function Theory, Godel Numbering.

**Text Books**

1. John E. Hopcroft, Jeffrey D.Ullman, Automata Theory, Languages, and Computation.

**Reference Books**

1. Peter Linz, An Introduction to Formal Languages and Automata, 4th edition.

**Modes of Evaluation: Quiz/Assignment/ Presentation/ Extempore/ Written Examination**

**Examination Scheme:**

|  |  |  |  |
| --- | --- | --- | --- |
| **Components** | **MSE** | **Presentation/Assignment/ etc** | **ESE** |
| **Weightage (%)** | **20** | **30** | **50** |

**Relationship between the Course Outcomes (COs), Program Outcomes (POs) and Program Specific Objectives (PSOs)**

|  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| **Course Outcomes** | **PO1** | **PO2** | **PO3** | **PO4** | **PO5** | **PO6** | **PO7** | **PO8** | **PO9** | **PO10** | **PO11** | **PO12** | **PSO1** | **PSO2** | **PSO3** |
| **CO1** |  | 3 | 2 | 2 |  |  |  |  |  |  |  |  | 2 |  |  |
| **CO2** |  | 3 | 2 | 2 |  |  |  |  |  |  |  |  | 2 |  |  |
| **CO3** |  | 3 | 2 | 3 |  |  |  |  |  |  |  |  | 2 |  |  |
| **CO4** |  | 3 | 2 | 3 |  |  |  |  |  |  |  |  | 2 |  |  |
| **Average** |  | 3 | 2 | 2.5 |  |  |  |  |  |  |  |  | 2 |  |  |

1= Weak 2= Moderate 3= Strong