Theoretical Computer Science

Semester V **Subject Code: BS51702** **Lectures: 60**

Objectives:

The syllabus aims in equipping students with,

- To design compiler using automata theory
- To have an introductory knowledge of automata, formal language theory and computability
- To have an understanding of finite state machine and pushdown automata
- To have a knowledge of regular languages and context free languages
- To know the relation between regular language, context free language and corresponding recognizers
- To study the Turing machine and classes of problems

Unit 1: Introduction 06

Ch 1. Introduction

- Symbol, Alphabet, String, Prefix& & Suffix of Strings, Formal Language, Operations on Languages.
- Set, operations on set, Relations, Properties of relations-Symmetric, Transitive, Reflexive, Equivalence Relation.
- Regular Expressions (RE) : Definition & Examples
- Regular Expressions Identities.
- Grammar - Definition and Examples.
- Chomsky Hierarchy.

Unit 2: Finite Automata and Regular Grammar, Languages 19

Ch 2. Finite Automata

- Deterministic finite Automaton – Definition, DFA as language recognizer, DFA as a pattern recognizer.
- Nondeterministic finite automaton – Definition and Examples.
- NFA with ε- transitions Definition and Examples.
- NFA with ε-Transitions to DFA & Examples
- Finite automaton with output – Mealy and Moore machine, Definition and Examples.
- Minimization of DFA using Myhill Nerode Theorem, Algorithm & Problem using Table Method.

Ch 3. Regular Grammar and Languages

- Regular Grammar: Definition & Examples.
- Left linear and Right Linear Grammar-Definition and Example.
- Regular language-Definition and Examples.
- Pumping lemma for regular languages and applications

- Closure properties of regular Languages
  (Union, Concatenation, Complement, Intersection and Kleen closure)
- Conversion of RE To FA-Examples and FA to RE-Examples using Arden's theorem.
- Equivalence of FA & Regular Grammar
  - ➢ Construction of regular grammar equivalent to a given DFA
  - ➢ Construction of a FA from the given right linear grammar

Unit 3: Context Free Grammar, Languages and Pushdown Automaton 15

Ch 4. Context Free Grammar and Languages

- CFG : Definition & Examples.
- Derivation-Reduction - Definition and Examples.LMD, RMD, Parse Tree
- Ambiguous Grammar: Concept & Examples.
- Simplification of CFG :
  - ➢ Removing Useless Symbols,
  - ➢ Removing unit productions
  - ➢ Removing ϵ productions & Nullable symbols
- Normal Forms :
  - ➢ Chomsky Normal Form (CNF) Method & Problem
  - ➢ Greibach Normal form (GNF) Method & Problem
- Closure Properties of CFL's(Union, concatenation and Kleen closure)

Ch 5. Push Down Automaton

- Definition of PDA and examples
- Construction of PDA using empty stack and final State method : Examples using stack method
- Definition DPDA & NPDA, their correlation and Examples of NPDA
- CFG (in GNF) to PDA : Method and examples

Unit 4: Recursive, Recursively enumerable Languages and Turing Machine 8

Ch 6. Turing Machine

- Recursive Languages Recursive and Recursively enumerable Languages, Difference between recursive and recursively enumerable language.
- The Turing Machine Model and Definition of TM
- Design of Turing Machines
- Language accepted by TM
- Problems on language recognizers.
- Introduction to LBA (Basic Model).(Without Problems)
- Types of Turing Machines-Multitrack TM, Two way TM, Multitape TM, Non-deterministic TM
- Turing Machine Limitations
- Halting Problem of TM

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***Contact hours – 12 hours**

Reference Books:

1. John E. Hopcroft and Jeffrey Ullman, *Introduction to Automata theory, Languages and computation*, Narosa Publishing House.
2. John Hopcroft, Rajeev Motwani and Jeffrey Ullman, *Introduction to Automata theory, Languages and computation,* Third edition Pearson Education.
3. Daniel I. A. Cohen, *Introduction to Computer Theory,* John Wiley & Sons, 2^{nd} edition.
4. K. L. P. Mishra & N. Chandrasekaran, *Theory of Computer Science (Automata, Language & Computation)*, PHI Second Edition.
5. John C. Martin, *Introduction to Languages and The Theory of Computation*, TMH, Second Edition .
6. PETER LINZ, *An introduction Formal Languages and Automata*, Fifth edition.