COURSE HANDOUT

THEORY OF COMPUTATION & COMPILER DESIGN (PSCSATC-321)

MCA- 3RD SEMESTER

ACADEMIC YEAR (2024-25)

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Course Code	Course Name	Course Type	Cd	L	T	P	Marks		
							Sessional	Final Exam	Total
PSCSATC-321	Theory of Computation & Compiler Design	Core	4	4	0	0	40	60	100

COURSE OUTCOMES

At the end of the course the student will be able to:	
CO1	Apply mathematical foundations, algorithmic principles and computer science theory to the modelling and design of computational systems.
CO2	Demonstrate knowledge of basic mathematical models of computation and describe how they relate to formal languages
CO3	Understand the limitations of computers and know about unsolvable problems.
CO4	Understand different phases, intermediate representations, algorithms, and principles of working of a compiler
CO5	Apply parsing techniques, error handling and understanding of various issues in compiler design for optimized performance.

Unit-I

Regular languages and Expressions: Symbols, Alphabet, Strings, Backus-Naur Form, Languages, Grammar, Classification of Grammars, Regular Set, Regular expressions, Algebra of Regular expressions, Regular grammar, Regular languages, Closure properties of Regular languages, Applications of regular expressions. Deterministic Finite Automata (DFA) Non-Deterministic Finite Automata (NFA), ε-NFA, Equivalence Finite Automata, Equivalence of Regular Expression and Finite Automata, Pumping Lemma for Regular Languages, Applications of finite automata, Mealy and MooreMachines

Unit-II

Context Free Grammar: Production rules and derivation, Types of Productions, Reduction of Grammar, Chomsky Normal Form, Griebach Normal Form, Pushdown Automata (PDA), Equivalence between CFG and PDA, Context Free Language, Closure properties for context free languages, Pumping Lemma for Context free languages, Applications of Context Free Grammar

Unit-III

Turing Machines: Description, Transition diagram, Roles of Turing machine, Church-Turing Thesis,Modular Construction of complex Turing machines, Extensions of Turing machines, Non- Deterministic Turing Machines. Universal Turing Machine, Turing acceptable and Turing decidable languages. Decidable and Undecidable Problems, The Halting Problem, Reduction to Another Undecidable Problem, Undecidability of Post Correspondence Problem

Unit- lV

Compiler Structure & Front end: Compilers and Translators, Analysis- Synthesis Model of Compilation, Various Phases of Compiler.

Lexical Analysis: Interface with input, parser and symbol table, token, lexeme and patterns, difficultiesin lexical analysis, Error Reporting, LEX., Capabilities of Lexical Analyzer. Basic Parsing Techniques:Top-Down parsers with backtracking, Recursive Descent Parsers, Predictive Parsers, Non-recursive Predictive Parsers

Unit-V

Errors Detection and Recovery, Code generation & optimization: Bottom–up Parsers, Shift- Reduce Parsing, Operator Precedence Parsers, LR parsers. Error Detection and Recovery: Lexical phase errors, Syntactic phase errors, Semantic errors. Intermediate Code Generation: Different Intermediate forms: three address code, Quadruples & Triples. Sources of optimization, Local optimization, Peephole optimization Code Generation: Issues in the design of Code Generator, Basic Blocks and Flow Graphs, Transformations on Basic Blocks, Code Generation Algorithm, Register Allocation and Assignment

Textbooks

S.No	Name of the Books	Name of the Author	Publisher Name	Edition (Pub.Yr.)
1	Elements of the Theory of Computation	H. R. Lewis and C. H. Papadimitriou	Prentice Hall of India	2nd (1998)
2.	Principles of Compiler Design,	Alfred V Aho, Jeffery D. Ullaman	Narosa Publishing House	2nd (2007)

Reference Books

S.No	Name of the Books	Name of the Author	Publisher Name	Edition (Pub.Yr.)
3	Languages and Computation	J. E. Hopcroft, R. Motwani and J. D Ullman, "Introduction to Automata Theory	Pearson Education Asia	3rd (2008)
4	Introduction to the Theory of Computation	Michael Sipser	Thompson	2nd (2006)
5	Theory of Computer Science	K. L. P. Mishra and N. Chandrasekaran	Prentice Hall	3rd (2006)
6	Theory of Recursive Functions and effective computing	Rogers H	Mcgraw-Hill	2nd (2006)
7	Introduction to Languages and Theory of Computation	J. C. Martin	Tata Mcgraw Hill,	3rd (2007)

COURSE PLAN

Unit-I Regular languages and Expressions

S.No	Topics	Recommended Books
1	Symbols, Alphabet, Strings, Backus-Naur Form	Book 5, Ch.4
2	Languages, Grammar, Classification of Grammars	Book 5, Ch.4
3	Regular Set, Regular expressions, Algebra of Regular expressions, Regular grammar, Regular languages, Closure properties of Regular languages, Applications of regular expressions	Book 5, Ch.5

4	Deterministic Finite Automata (DFA) Non-Deterministic Finite Automata (NFA), ε-NFA	Book 5, Ch.3
5	Equivalence Finite Automata, Equivalence of Regular Expression and FiniteAutomata	Book 5, Ch.3
6	Pumping Lemma for Regular Languages, Applications of finite automata	Book 5, Ch.3
7	Mealy and Moore Machines	Book 5, Ch.3
Unit-II Context Free Grammar		
8	Production rules and derivation, Types of Productions, Reduction of Grammar	Book 5, Ch.6
9	Chomsky Normal Form, Griebach Normal Form	Book 5, Ch.6
10	Pushdown Automata (PDA), Equivalencebetween CFG and PDA	Book 5, Ch.7
11	Context Free Language, Closure properties for context free languages	Book 5, Ch.6
12	Pumping Lemma for Context free languages, Applications of Context Free Grammar.	Book 5, Ch.6
Unit-III Turing Machines		
13	Description, Transition diagram, Roles of Turing machine	Book 5, Ch.9
14	Church-Turing Thesis, Modular Construction of complex Turing machines, Extensions of Turing machines	Book 5, Ch.12
15	Non- Deterministic Turing Machines. Universal Turing Machine, Turing acceptable and Turing decidable languages	Book 5, Ch.9
16	Decidable and Undecidable Problems, The Halting Problem	Book 5, Ch.10
17	Reduction to Another Undecidable Problem, Undecidability of Post Correspondence Problem	Book 5, Ch.10
Unit-IV Compiler Structure & Front end		
18	Compiler Structure: Compilers and Translators	Book 2, Ch.1
19	Analysis-Synthesis Model of Compilation, Various phases of compiler.	Book 2, Ch.1
20	Lexical Analysis: Interface with input, parser and symbol table, token, lexeme and patterns, difficultiesin lexical analysis, Error Reporting, LEX., Capabilities of Lexical Analyzer	Book 2, Ch.3
21	Basic Parsing Techniques:Top-Down parsers with backtracking	Book 2, Ch.4
22	Recursive Descent Parsers, Predictive Parsers, Non-recursive Predictive Parsers	Book 2, Ch.4
Unit-V Errors Detection and Recovery, Code generation & optimization		
23	Bottom–up Parsers, Shift- Reduce Parsing, Operator Precedence Parsers, LR parsers.	Book 2, Ch.4
24	Error Detection and Recovery: Lexical phase errors, Syntactic phase errors, Semantic errors	Book 2, Ch.4
25	Intermediate Code Generation: Different Intermediate forms: three address code, Quadruples & Triples.	Book 2, Ch.6
26	Sources of optimization, Local optimization, Peephole optimization Code Generation: Issues in the design of Code Generator	Book 2, Ch.8
27	Basic Blocks and Flow Graphs, Transformations on Basic Blocks	Book 2, Ch.8
28	Code Generation Algorithm, Register Allocation and Assignment	Book 2, Ch.8

ADDITIONAL WEB RESOURCES

1.	**MOOC:** An introductory course on Theory of Computation https://onlinecourses.nptel.ac.in/noc19_cs79/preview
2.	**NPTEL:** Video lectures on Theory of Computation, Lecture series by Prof. Raghunath Tewari, IIT Kanpur https://nptel.ac.in/courses/106104148

GRADING AND ASSESSMENT

- **Sessional Test**: 20 marks
- **Assignment**: 10 marks
- **Attendance**: 10 marks
- **Final Examination**: 60 marks

COURSE POLICIES

- **Attendance**: Minimum 75% attendance is mandatory to appear in the final examination of the course.
- **Academic Integrity**: MIET's academic integrity policies apply. Plagiarism will not be tolerated.
- **Late Submissions**: Assignments and projects must be submitted by the specified timelines.

FACULTY INFORMATION

- **Office Hours**

  Monday (12:55 PM - 1:45 PM)
  Friday (12:55 PM - 1:45 PM)

- **Contact Information**
  anil.cse@mietjammu.in