



Kot Bhalwal, Jammu



Model Institute of Engineering  
& Technology (Autonomous)  
Course Handout

## COURSEHANDOUT

Theory of Computation ,COM-503

CSE-5<sup>th</sup>SEMESTER

ACADEMIC YEAR(2024-25)

**Mr. Anil Gupta**

Sr.Assistant Professor

**Department of Computer Science and Engineering**



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Kot Bhalwal, Jammu -

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Dr. Arun K. Gupta Teaching-Learning Centre

Version 1.1



Please Do Not Print Unless Necessary

**Detailed Syllabus:**

Course Code	CourseName	CourseType	Cd	L	T	P	Marks		
							Sessional	Final Exam	Total
COM-503	Theory of Computation	PCC	4	3	1	0	50	100	150

**CourseOutcomes:**

At the end of the course the student will be able to:	
CO1	Understand the key notions of computation: Algorithm, computability, decidability, reducibility, complexity, and apply these concepts through problem-solving.
CO2	Understand the models of computation: Formal languages, grammars, automata, their connections, and applications.
CO3	Articulate and explain the Church-Turing thesis: Understand its significance in the theory of computation.
CO4	Analyze and design computational models: Finite automata, pushdown automata, Turing machines, formal languages, and grammars.
CO5	Solve computational problems: Evaluate their computability and complexity, and prove the basic results of the theory of computation.

**Section-A**

Unit 1: Finite Automata: Deterministic Finite Automata (DFA), Designing, Non-deterministic finite Automata (NFA) without E-moves, Conversions, Equivalence, NFA with E-moves, Regular expression designing, Finite machine with output assigned, Moore and Mealy machines, Conversion and Equivalence, Myhill-Nerode Theorem. (12 hrs)

Unit 2: Regular Grammar & Context Free Languages: Context free Grammar, Context free Languages, reduced form of Grammar, Ambiguous and Non-Ambiguous grammar, acceptors and generators, Relations between Classes of Languages, Pumping lemma of regular sets, Chomsky's hierarchy of languages, derivation Trees, CYK Algorithm for CFL Membership, Testing emptiness of CFLs. (10 hrs)

**Section-B**

Unit 3: Turing Machines: Church Testing Hypothesis, Turing Computability, Non-deterministic, Multitape and other versions of Turing machines, Church's Hypothesis, Primitive Recursive functions, Universal Turing machines, decidability, Halting problem, Stack Automata. (8 Hrs)

Unit 4: Push Down Automata: Definition, Model, Acceptance of CFL, Acceptance by Final State and Acceptance by Empty stack and its Equivalence, Equivalence of CFG and PDA. (6 Hrs)



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Unit 5: Recursive and Recursively Enumerable Languages (rel): Properties of recursive and recursively enumerable languages, Context sensitive language and linear bounded automata (LBA), Chomsky hierarchy, Decidability, Post's correspondence problem (PCKP), undecidability of PCP. (6Hrs)

**TextBooks**

S.No.	NameoftheBooks	Author	Publisher	Edition(Pub.Yr.)
1	Introduction to Automata Theory, Languages, and Computation	Hopcroft, J., Ullman, J. D., & Motwani, R.	Pearson	3 <sup>rd</sup> (2018)
2	Elements of the Theory of Computation	Lewis, H. R., & Papadimitriou, C. H.	Pearson	2 <sup>nd</sup> (2021)

**ReferenceBooks**

S.No.	NameoftheBooks	Author	Publisher	Edition(Pub.Yr.)
1	IntroductiontoAutomataTheory,LanguagesandComputation	John E. Hopcroft andJeffreyD.Ullman.	Pearson	3 <sup>rd</sup> (2018)

**COURSEPLAN**

**Unit-I Finite Grammar**

S.No	Topics	RecommendedBooks
1	Concept of Automata, strings ,Language	Book 1, Ch.1
2	String Concatenation, Alphabet	Book 1,Ch.1
3	States, Transition Tables	Book 1,Ch.1
4	Finite Automata , Regular Expression	Book 2,Ch.2
5	Push Down Automata, Turning Automata	Book 2,Ch.2
6	Myhill-Nerode Theorem	Book 2,Ch.2
7	Moore-Mealy Machines	Book 2,Ch.2
Unit-II Regular Grammar & Context Free		
8	Introduction to DFA	Book 1, Ch.2
9	Designing NDFA without E-Moves	Book 1,Ch.2
10	Designing with E-Moves	Book 1,Ch.1
11	Regular Expression Designing	Book 2,Ch.2



12	<b>Ambiguous Grammar</b>	Book 2,Ch.2
13	<b>Non-Ambiguous Grammar</b>	Book 2,Ch.2
14	<b>Regular Expression examples</b>	Book 2,Ch.2
15	<b>Acceptors and Generators</b>	Book 2,Ch.2
<b>Unit-III Turing Machine</b>		
16	<b>Multi-Tape other versions of TM</b>	Book 2,Ch.2
17	<b>Churches Hypothesis</b>	Book 2,Ch.2
18	<b>Primitive Recursive Functions</b>	Book 2,Ch.2
19	<b>Universal TM,</b>	Book 2,Ch.2
20	<b>Halting problem</b>	Book 2,Ch.2
21	<b>Stack Automata</b>	Book 2,Ch.2
<b>Unit-IV Push-Down Automata</b>		
22	<b>Formal Definition of Push -Down Automata</b>	Book 2,Ch.5
23	<b>Languages Accepted by PDA</b>	Book 1,Ch.4
24	<b>Representation of PDA</b>	Book 1,Ch.4
25	<b>Relationship b/w CFG &amp; PDA</b>	Book 2,Ch.5
26	<b>Deterministic PDA</b>	Book 1,Ch.4
27	<b>Parsing &amp; PDA</b>	Book 2,Ch.5
28	<b>Additional solved Examples</b>	Book 1,Ch.4
<b>Unit-V Recursive &amp; Recursively Enumerable</b>		
29	<b>Properties of Recursive and Recursive Enumerable languages</b>	Book 2,Ch.8
30	<b>Context Sensitive language</b>	Book 1,Ch.8
31	<b>Linear Bounded Automata(LBA)</b>	Book 2,Ch.8
32	<b>Chomsky Hierachy</b>	Book 1,Ch.8
33	<b>PCKP(Post's correspondence problem)</b>	Book 2,Ch.8
34	<b>Unrestricted Grammar</b>	Book2,Ch. 8

**ADDITIONAL WEB RESOURCES:**

1	<p><b>NPTEL LINK:</b>  <a href="https://nptel.ac.in/courses/106104148">https://nptel.ac.in/courses/106104148</a>            This link contains NPTEL lectures of Theory of Computation by Prof. Raghunath Tiwari, IIT Kanpur.            Link refereed: 13/01/2024</p>
2.	<p><b>CASESTUDY:</b><a href="https://www.researchgate.net/publication/285599038">https://www.researchgate.net/publication/285599038</a> <b>Finite State Machine Case study of Air conditioning system</b>            This Case study focussed on the mathematical model of computation on Finite Automata, exploited the design of computer programming and sequential logic circuits.</p>
2	<p><b>TUTORIAL LINK:</b>  <a href="https://sites.google.com/site/sajalsahaofficial/formal-language-and-automata-theory-cs-402-1">https://sites.google.com/site/sajalsahaofficial/formal-language-and-automata-theory-cs-402-1</a>            This link that deals with designing abstract self propelled computing devices that follow a predetermined sequence of operations automatically.</p>
3	<p><b>PREVIOUS YEAR PAPERS:</b>  <a href="https://www.manareresults.co.in/download.php?subcode=RT22055">https://www.manareresults.co.in/download.php?subcode=RT22055</a>            List of expected questions from various universities.</p>
4	<p><b>SOFTWARE LINK: JFLAP software for running various applications on automata.</b>  <a href="https://softfamous.com/jflap/">https://softfamous.com/jflap/</a> ,  <a href="https://lecturenotes.in/practicals/27522-lab-manuals-for-formal-languages-and-automata-theory-flat-by-manish-lal">https://lecturenotes.in/practicals/27522-lab-manuals-for-formal-languages-and-automata-theory-flat-by-manish-lal</a> ,</p>



### GRADING AND ASSESSMENT

- **Sessional Test:** 20 marks
- **Assignment:** 20 marks
- **Attendance:** 10 marks
- **Final Examination:** 50 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 project must be submitted by the specified timelines.

### FACULTY INFORMATION

- **Office Hours**  
Monday (12:05 PM - 12:55 PM)  
Friday (12:05 PM - 12:55 PM)
- **Contact Information**  
[anil.cse@mietjammu.in](mailto:anil.cse@mietjammu.in)