COURSE HANDOUT

Theory of Computation, COM-604

CSE-6th SEMESTER

ACADEMIC YEAR (2024-25)

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Detailed Syllabus:

Course Code	Course Name	Course Type	Cd	L	T	P	Marks		
							Sessional	Final Exam	Total
COM-604	Theory of Computation	PCC	4	3	1	0	50	100	150

Course Outcomes:

At the end of the course the student will be able to:	
CO1	Understand the key notions of computation, such as algorithm, computability, decidability, reducibility, and complexity, through problem solving.
CO2	Understand the models of computation, including formal languages, grammars and automata, and their connections.
CO3	Articulate and explain the Church-Turing thesis and its significance.
CO4	Analyze and design finite automata, pushdown automata, Turing machines, formal languages, and grammars.
CO5	Solve computational problems regarding 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.

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.

Section-B

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

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.

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.

Text Books

S. No.	Name of the Books	Author	Publisher	Edition (Pub. Yr.)
1	Introduction to Automata Theory, Languages and Computation	J Hopcroft, JD Ullman,R Motwani,	Pearson	3rd (2008)
2	Elements of the Theory of Computation	Lewis, H.R. and Papadimitriou	Pearson	2nd (2015)

Reference Books

S. No.	Name of the Books	Author	Publisher	Edition (Pub. Yr.)
1	Introduction to Automata Theory, Languages and Computation	John E. Hopcroft and Jeffrey D. Ullman.	Pearson	3rd (2008)

Unit-I Finite Grammar		
S.No	**Topics**	**Recommended Books**
1.1	**Introduction to Theory of Computation**	Book 1, Ch.1
1.2	**Generalized Transition Graphs**	Book 1, Ch.1
1.3	**Concept of Automata, strings, Language Deterministic Finite Automata (DFA)**	Book 1, Ch.1
1.4	**Simpler Notations for DFA**	Book 2, Ch.2
1.5	**The language of DFA and Facts in designing procedure of FA**	Book 2, Ch.2
1.6	**Extending Transition Function to Strings in DFA**	Book 2, Ch.2
1.7	**Designing the DFA, States, Transition Tables**	Book 2, Ch.2
1.8	**NFA without E moves**	
1.9	**Conversions NFA to DFA**	Book 1, Ch.1
1.10	**Equivalence of NFA and DFA**	Book 1, Ch.1
1.11	**NFA with E-moves**	Book 1, Ch.1
1.12	**Regular expression designing**	Book 2, Ch.2
1.13	**Finite machine with output assigned**	Book 2, Ch.2
1.14	**Moore-Mealy Machines**	Book 2, Ch.2
1.15	**Conversion and Equivalence**	Book 2, Ch.2
1.16	**Myhill-Nerode Theorem**	Book 2, Ch.2
Unit-II Regular Grammar & Context Free		
2.1	**Context-free Grammar, Context-Free Languages**	Book 1, Ch.2
2.2	**Reduced form of Grammar**	Book 1, Ch.2
2.3	**Ambiguous and non-ambiguous grammar**	Book 1, Ch.1
2.4	**Acceptors and generators**	Book 2, Ch.2
2.5	**Relations between Classes of Languages**	Book 2, Ch.2
2.6	**Pumping lemma of regular sets**	Book 2, Ch.2
2.7	**Chomsky's hierarchy of languages**	Book 2, Ch.2
2.8	**Derivation Trees**	Book 2, Ch.2
2.9	**CYK Algorithm for CFL Membership**	Book 2, Ch.2
2.10	**Testing emptiness of CFLs**	Book 2, Ch.2
Unit-III Turing Machine		
3.1	**Church Testing Hypothesis, Turing Computability**	Book 2, Ch3
3.2	**Non- deterministic, Multitape and other versions of Turing machines**	Book 2, Ch.2
3.4	**Churches Hypothesis**	Book 2, Ch.2
3.5	**Primitive Recursive functions**	Book 2, Ch.2
3.6	**Universal Turing machines**	Book 2, Ch.2
3.7	**Decidability**	Book 2, Ch.2
3.8	**Halting problem**	Book 2, Ch.2
3.9	**Stack Automata**	Book 2, Ch.2

Unit-IV Push-Down Automata		
4.1	**Formal Definition of Push -Down Automata**	Book 2, Ch.5
4.2	**Model of push down automata**	Book 1, Ch.4
4.3	**Acceptance of CFL**	Book 1, Ch.4
4.4	**Acceptance by Final State and Acceptance by Empty stack and its Equivalence**	Book 2, Ch.5
4.5	**Equivalence of CFG**	Book 1, Ch.4
4.6	**Equivalence of PDA**	Book 2, Ch.5
Unit-V Recursive & Recursively Enumerable		
5.1	**Properties of recursive and recursively enumerable languages**	Book 2, Ch.8
5.2	**Context-sensitive language and linear bounded automata (LBA)**	Book 2, Ch.8
5.3	**Chomsky hierarchy**	Book 2, Ch.8
5.4	**Decidability**	Book 2, Ch.8
5.5	**Post's correspondence problem (PCKP)**	Book 2, Ch.8
5.6	**Undecidability of PCP**	Book 2, Ch.8

ADDITIONAL WEB RESOURCES:

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

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 projects 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**
  rajneet.cse@mietjammu.in