



# MANIPAL UNIVERSITY JAIPUR

School of Information Technology

Department of Information Technology

Course Hand-Out

Compiler Design Lab | IT 3230 | 1 Credits | 0 0 2 1

Session: January 2024 – May 2024 | Faculty: Dr. Prakash Chandra Sharma (Course Coordinator)

**A. Introduction:** This course is meant to provide an understanding of design of abstract models of computation, the language translation patterns by designing different automata machine say finite automata, PDA, Turing machine. Also try to understand the implementation aspects of regular expression, regular language and context free language. Students would learn to use two language processing tools LEX and YACC.

**B. Course Outcomes:** At the end of the course, students will be able to

- [3230.1].** Identify string patterns from given input text.
- [3230.2].** Identify the type of a given grammar according to Chomsky Hierarchy of languages.
- [3230.3].** Design and Implementation of different automata machine like Finite Automata, Push Down Automata, and Turing Machine.
- [3230.4].** Identify the behaviour of context free grammar say left recursive and left factored grammars from given CFG.
- [3230.5].** Demonstrate the use of LEX and YACC.

**C. Vision, Mission, Program Educational Objectives**

**Vision:**

To achieve global excellence in higher education, research, and human development by adapting innovations in IT domain.

**Mission:**

1. To become the most inspirational department among the students and engineering aspirants who want to pursue their career in the field of Information Technology.
2. To foster academic, research, and professional excellence within the domain of Information Technology.
3. To transform young minds into competent IT professionals imbibing strong moral values.

**Program Educational Objectives (PEOs)**

**PEO1:** Confidently demonstrate the required logical and technical problem-solving skills and technical competence to work in the field of IT and IT enabled services.

**PEO2:** Specify, analyse, design, and implement prototypes and working solutions for a wide range of real-life problems within the specified constraints.

**PEO3:** Pursue higher studies, grow in the direction of research and development, pave a way forward in the field of entrepreneurship while demonstrating remarkable professionalism, confidence, and a sense of responsibility.

**PEO4:** Engage in life-long learning, communicate effectively, and exhibit leadership skills.

**PEO5:** Demonstrate sensitivity towards ethical and environmental issues, and social responsibilities.

#### **D. PROGRAM OUTCOMES AND PROGRAM SPECIFIC OUTCOMES**

- [PO.1]. **Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.
- [PO.2]. **Problem analysis:** Identify, formulate, research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences
- [PO.3]. **Design/development of solutions:** Design solutions for complex engineering problems and design system components or processes that meet the specified needs with appropriate consideration for the public health and safety, and the cultural, societal, and environmental considerations
- [PO.4]. **Conduct investigations of complex problems:** Use research-based knowledge and research methods including design of experiments, analysis and interpretation of data, and synthesis of the information to provide valid conclusions.
- [PO.5]. **Modern Tool Usage:** Create, select, and apply appropriate techniques, resources, and modern engineering and IT tools including prediction and modeling to complex engineering activities with an understanding of the limitations.
- [PO.6]. **The Engineers and Society:** Apply reasoning informed by the contextual knowledge to assess societal, health, safety, legal, and cultural issues and the consequent responsibilities relevant to the professional engineering practice
- [PO.7]. **Environment and Sustainability:** Understand the impact of the professional engineering solutions in societal and environmental contexts, and demonstrate the knowledge of, and need for sustainable development.
- [PO.8]. **Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practices.
- [PO.9]. **Individual and Teamwork:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.
- [PO.10]. **Communication:** Communicate effectively on complex engineering activities with the engineering community and with society at large, such as, being able to comprehend and write effective reports and design documentation, make effective presentations, and give and receive clear instructions.
- [PO.11]. **Project Management and Finance:** Demonstrate knowledge and understanding of the engineering and management principles and apply these to one's own work, as a member and leader in a team, to manage projects and in multidisciplinary environments.
- [PO.12]. **Life-long Learning:** Recognize the need for and have the preparation and ability to engage in independent and life-long learning in the broadest context of technological change.

#### **Program Specific Objectives (PSOs)**

- [PSO.1] To apply innovative and creative techniques to design, simulate, implement complex IT solutions while leveraging- existing and cutting-edge technologies.
- [PSO.2] To succeed to achieve inspiring IT oriented Jobs and competitive examinations that offer promising and satisfying careers.
- [PSO.3] To recognize the importance of professional developments by pursuing postgraduate studies and positions.

**E. Assessment Plan:**

Criteria	Description	Maximum Marks
Internal Assessment (Summative)	<b>Continuous Lab Evaluation 1 &amp; 2:</b> Lab Record File + Program Execution + Viva  First Evaluation: After 4 <sup>th</sup> Lab Second Evaluation: After 7 <sup>th</sup> Lab  <b>Final Marks: Average of both lab evaluation</b>	15 + 15 + 15 = 45
	Research Assignment / Mini Project	15
End Term Exam (Summative)	<b>End Term Exam Components</b>	
	1. One program execution on PC & code writing on answer sheet	15 + 10 = 25
	2. One question of automata designing	05
	3. Viva / Quiz	10
	<b>Total</b>	<b>100</b>
Attendance (Formative)	A minimum of 75% Attendance is required to be maintained by a student to be qualified for taking up the End Semester examination. The allowance of 25% includes all types of leaves including medical leaves.	
Make up Assignments (Formative)	As per department's directives	

**F. Syllabus**

Implementation of FA, PDA, TM for given languages, Identification of left factoring and left recursion from given CFG. Identification of regular expression and string pattern. **Basic Introduction:** Preliminary Scanning Applications; Lexical Analysis: Design and Implementation of Lexical Analyzer; Parsing: Design and Implementation of Parser, Implementation of Code Generator; Lex and YACC: Programs using LEX, Programs using YACC.

**G. Textbooks**

- T1.** An Introduction to Formal Languages and Automata – Peter Linz, Jones and Bartlett Student Edition, Fifth Edition, 2010.
- T2.** Compilers: Principles, Techniques and Tools – A. Aho, J. Ullman, M. S. Lam, R. Sethi, Pearson Education, 2nd Edition, 2007.

**H. Reference Books**

- R1.** Alfred V. Aho, Monica S. Lam, Ravi Sethi, Jeffrey D. Ullman, Compilers Principles, Techniques and Tools, (2e), Pearson Education India, 2013.
- R2.** D. M. Dhamdhare, Systems Programming and Operating Systems, (2e Revised), Tata McGraw Hill, 2009.
- R3.** Kenneth C. Louden, Compiler Construction - Principles and Practice, (1e), Thomson Press India, 2007.

**I. Online Lecture Plan:**

Lab No	Topics	Session Outcome	Mode of Delivery	Corresponding CO	Mode of Assessing the Outcome
1-2	Identify the terminal, non-terminals, keywords from given grammar/language. Count characters, words, whitespaces, vowels, consonants and number of new lines in a given string/file.	Understand the basic string operation and pattern matching concept.	Lab	3230.1	Continuous Evaluation Mid Term Examination End Term Examination
3	Identify the type of a given grammar according to Chomsky Hierarchy of languages	Understand Chomsky Hierarchy of languages	Lab	3230.1	Continuous Evaluation Mid Term Examination End Term Examination
3-6	Introduction and simulation of the behaviours of some sample DFA, Mealy machines and Moore machines	Implementing the behaviour of DFA	Lab	3230.2	Continuous Evaluation Mid Term Examination End Term Examination
7-8	Design and implementation of Push Down Automata. Implementation of the behaviour of left recursion and left factoring.	Designing of PDA and Understand the behaviour of left recursion and left factoring.	Lab	3230.2 3230.3	Continuous Evaluation Mid Term Examination End Term Examination
9	Implementation of Turing Machine.	Implementing the behaviour of Turing Machine	Lab	3230.3 3230.4	Continuous Evaluation End Term Examination
10-12	Demonstrate the use of LEX and YACC	Demonstrate lexical analysis and syntax analysis using tools.	Lab	3230.5	Continuous Evaluation End Term Examination

**J. Course Articulation Matrix: (Mapping of COs with POs)**

CO	STATEMENT	CORRELATION WITH PROGRAM OUTCOMES												CORRELATION WITH PROGRAM SPECIFIC OUTCOMES		
		PO 1	PO 2	PO 3	PO 4	PO 5	PO 6	PO 7	PO 8	PO 9	PO 10	PO 11	PO 12	PSO 1	PSO 2	PSO 3
[ IT3230.1]	Identify the type of a given grammar according to Chomsky Hierarchy of languages	3	2	3	1	1	1	1		1	1	1		2	2	1
[ IT3230.2]	Design Finite Automata, Mealy Machine, Moore Machine and Push Down Automata.	3	3	3	1	2	1	1	1	1	1			3	1	
[IT3230.3]	Identify left recursive and left factored grammars in given CFG	1	1		1	2			1			1		3	1	
[IT3230.4]	Identify string patterns from given set of contexts.	3	3	3	2	2		1	1				1	2	1	1
[IT3230.5]	Make use of the LEX and YACC tools.	3		1										3	1	1

**1- Low Correlation; 2- Moderate Correlation; 3- Substantial Correlation**