

SEMESTER S6
COMPILER DESIGN
(Common to CS/CD/CU/CC/CN/CB)

Course Code	PCCST601	CIE Marks	40
Teaching Hours/Week (L: T:P: R)	3:1:0:0	ESE Marks	60
Credits	4	Exam Hours	2 Hrs 30 Min.
Prerequisites (if any)	PCCST302	Course Type	Theory

Course Objectives:

1. To provide a comprehensive understanding of the compiler construction process through its various phases viz. lexical analysis, parsing, semantic analysis, code generation, and optimization.
2. To introduce compiler construction tools like Lex and YACC and use them in lexical analysis and parsing.

SYLLABUS

Module No.	Syllabus Description	Contact Hours
1	Introduction - Compiler Structure, Overview of Translation: The Front End; The Optimizer; The Back End. Scanners - Recognizing Words, Regular Expressions, From Regular Expression to Scanner: FSA (Brush-up only), Implementing Scanners <i>Hands-on: Recognizing Words with Lex, Regular Expressions in Lex</i>	6
2	Parsing - Introduction, Expressing Syntax Top-Down Parsing - Transforming A Grammar: Eliminating Left Recursion; Backtrack-free Parsing; Left-Factoring To Eliminate Backtracking, Recursive Descent Parsers, Table-Driven LL(1) Parsers	10

3	<p>Bottom-Up Parsing - Shift Reduce Parser, The LR(1) Parsing Algorithm, Building LR(1) Tables, Errors in the Table Construction, Reducing the Size of LR (1) Tables.</p> <p><i>Hands-on: Building a calculator with YACC</i></p> <p>Intermediate Representations: An IR Taxonomy, Graphical IRs - Syntax-Related Trees, Graphs; Linear IRs - Stack-Machine Code - Three-Address Code - Representing Linear Codes</p> <p>Syntax-Driven Translation: Introduction, Translating Expressions, Translating Control-Flow Statements</p>	16
4	<p>Code generation: Code Shape - Arithmetic Operators, Boolean and Relational Operators, Control-Flow Constructs (Conditional Execution, Loops and Iteration, Case Statements only), Procedure Calls</p> <p>Code Optimization - Introduction, Opportunities for Optimization, Scope Of Optimization</p> <p>Local Optimization: Local Value Numbering, Tree-Height Balancing</p> <p>Regional Optimization: Superlocal Value Numbering, Loop Unrolling</p> <p>Global Optimization: Finding Uninitialized Variables with Live Sets, Global Code Placement</p>	14

Course Assessment Method

(CIE: 40 marks, ESE: 60 marks)

Continuous Internal Evaluation Marks (CIE):

Attendance	Assignment/ Microproject	Internal Examination-1 (Written)	Internal Examination- 2 (Written)	Total
5	15	10	10	40

End Semester Examination Marks (ESE)

In Part A, all questions need to be answered and in Part B, each student can choose any one full question out of two questions

Part A	Part B	Total
<ul style="list-style-type: none">• 2 Questions from each module.• Total of 8 Questions, each carrying 3 marks <p>(8x3 =24 marks)</p>	<ul style="list-style-type: none">• Each question carries 9 marks.• Two questions will be given from each module, out of which 1 question should be answered.• Each question can have a maximum of 3 subdivisions. <p>(4x9 = 36 marks)</p>	60

Course Outcomes (COs)

At the end of the course students should be able to:

Course Outcome		Bloom's Knowledge Level (KL)
CO1	Use lexical analysis techniques to build a scanner for a given language specification. (Cognitive Knowledge Level: Apply)	K3
CO2	Construct parse trees for input programs using parsing algorithms and detect syntactic errors. (Cognitive Knowledge Level: Apply)	K3
CO3	Develop semantic analysis techniques to check program correctness. (Cognitive Knowledge Level: Apply)	K3
CO4	Build intermediate code representations by applying intermediate code generation techniques. (Cognitive Knowledge Level: Apply)	K3
CO5	Optimize generated code using code optimization strategies to improve performance. (Cognitive Knowledge Level: Apply)	K3

Note: K1- Remember, K2- Understand, K3- Apply, K4- Analyse, K5- Evaluate, K6- Create

CO-PO Mapping Table (Mapping of Course Outcomes to Program Outcomes)

	PO1	PO2	PO3	PO4	PO5	PO6	PO7	PO8	PO9	PO10	PO11	PO12
CO1	3	3	3		3							2
CO2	3	3	3		3							2
CO3	3	3	3		3							2
CO4	3	3	3		3							2
CO5	3	3	3		3							2

Note: 1: Slight (Low), 2: Moderate (Medium), 3: Substantial (High), -: No Correlation

Text Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Engineering a Compiler	Keith D. Cooper, Linda Torczon	Elsevier Science	3/e, 2023
2	Lex and YACC	John R. Levine, Tony Mason, Doug Brown	O' Reily	2/e, 1992

Reference Books				
Sl. No	Title of the Book	Name of the Author/s	Name of the Publisher	Edition and Year
1	Compilers – Principles Techniques and Tools	Aho A.V., Ravi Sethi and D. Ullman.	Addison Wesley,	2/e, 2010.
2	Compiler Construction - Principles and Practice	Kenneth C Louden	Thomson Learning	1/e, 2007
3	Compiler Design in C	Allen Holub	Prentice-Hall software series	1/e, 1990
4	Modern Compiler Implementation in C	Andrew W. Appel	Cambridge University Press	2/e, 2004

Video Links (NPTEL, SWAYAM...)	
Module No.	Link ID
1-4	https://archive.nptel.ac.in/courses/106/105/106105190/