

**BITS PILANI, DUBAI CAMPUS**  
**ACADEMIC - UNDERGRADUATE STUDIES DIVISION**  
**SECOND SEMESTER 2023 – 2024**

**Course Handout (Part – II)**

Date: 05.02.2024

In addition to Part I (General Handout for all courses appended to the Time Table) this portion further specific details regarding the course.

**Course No.** : CS F363 (2 1 3)  
**Course Title** : Compiler Construction  
**Instructor-in-charge** : Dr. Elakkiya R  
**Course Instructors** : Dr. Elakkiya R, Dr. Angel Arul Jothi J

**Scope and Objective of the Course:**

This course aims at introducing the Lexical and Syntactic structure of a Language, the different phases of Compiler Design: Lexical Analysis, Syntax Analysis, Intermediate Code generation, Code Optimization, Code Generation; Error Handling, Table Management and involves practical on Lexical Analyzer, Parser, Symbol table, Semantic Analysis, Code Generation and Compiler Integration. At the end of the course, the students will be able to understand and apply the principles of compiler design in the development of system software tools & applications.

**Course Pre/Co-requisite (if any) & Catalogue/Bulletin Description:** *Given in the Catalogue 2023 – 2024*

**Text Book:**

**TB.** Aho, Lam, Sethi and Ullman, “Compilers-Principles, Techniques & Tools”, Pearson/Addison-Wesley, Second Edition, 2013.

**Reference book(s):**

**RB1.** Andrew W Appel & Jens Palsberg, “Modern Compiler Implementation in JAVA”, Cambridge University Press, Revised Edition, 2002.

**RB2.** Ravi Sethi, “Programming Languages: Concepts & Constructs”, Pearson International Edition, 2003, ISBN:0-321-21074-3.

**Course Plan:**

S.No	Learning Objectives	Topics to be covered	Text/Reference Book chapters	# lectures
1	Phases of compilers	Introduction to course. Structure and components of a compiler. Description of compiler phases	TB: Ch.1.1, 1.2	1
2	Lexical Analysis	The Role of lexical analyzer - Tokens, Patterns, Lexemes, Lexical Errors,	TB: Ch.3.1	4
		Input Buffering - Look Ahead & Sentinels	TB: Ch.3.2	
		Specification of Tokens - Regular Expressions, Regular definitions	TB: Ch.3.3	
		Recognition of Tokens - Transition Diagrams	TB: Ch.3.4	
		The Lexical-Analyzer Generator Lex	TB: Ch.3.5	
3	Syntax analysis	Introduction - Role of Parser, Syntax Errors and Recovery	TB: Ch. 4.1	15
		Context Free Grammars (CFG)- Parse Trees, Derivations, Ambiguity	TB: Ch. 4.2	
		Writing a Grammar – Eliminating Left Recursion, Left Factoring	TB: Ch. 4.3	
		Top-Down Parsing – Recursive Descent Parsing, First and Follow, LL (1) Grammars, Non-Recursive Predictive Parsing, Parsing table, Error Recovery	TB: Ch. 4.4	
		Bottom Up parsing – Reductions, Handle	TB: Ch. 4.5	

		Pruning, Shift Reduce Parsing, Conflicts		
		Introduction to LR Parsing: Simple LR	TB: Ch. 4.6	
		Powerful LR Parsers (if time permits)	TB: Ch. 4.7	
		Parser Generators	TB: Ch. 4.9	
4	Symbol Table	Data Structures for symbol table organization	TB: Ch. 2.7	2
5	Syntax Directed Translation	Inherited and Synthesized Attributes, evaluation order, dependency graph, evaluation of attributes, AST	TB: Ch. 2.3, 5.1, 5.2	3
6	Intermediate Code Generation	Variants of Syntax Trees	TB Ch 6.1-6.6	7
		Three-Address Code		
		Declarations, Storage Layout for Local Names, Sequences of Declarations, Fields in Records and Classes		
		Translation of Expressions		
		Control Flow		
7	Code Generation	Issues in the Design of a Code Generator	TB: Ch 8.1-8.2, 8.4-8.6, RB1: Ch 8.2	5
		The Target Language		
		Basic Blocks and Flow Graphs		
		Optimization of Basic Blocks		
		A Simple Code Generator		
8	Liveness Analysis & Data Flow equations	Uses, Defs, Liveness Analysis	RB1: Ch 10.1	2
9	Register Allocation	Register Allocation and Assignment	TB: Ch 8.8, RB1: Ch 11.1-11.2	2
10	Code Optimization	Peephole Optimization - Redundant Code Elimination, Flow of Control Optimization, Eliminating Unreachable Code, Algebraic Simplification and Reduction in Strength, Use of Machine Idioms	TB: Ch 8.7	1
		Machine-Independent Optimizations - Global Common Subexpressions, Copy Propagation, Dead-Code Elimination, Code Motion, induction variables and reduction in strength	TB: Ch. 9.1	1
11	Garbage Collection Overview	Techniques in GC and memory compaction	Class Notes RB1: Ch 13.1-13.3	1
12	Runtime Memory Models	Stack Allocation	TB: Ch. 7.2-7.3	1
	Total no of lectures planned			45

\* The lectures may be slightly diverging from aforesaid plan based on students 'background & interest in the topic, which may perhaps include special lectures and discussions that would be planned and schedule notified accordingly.

### List of Lab Experiments

S.No.	Lab Exercise
1	Lexical Analysis using LEX
2	Syntax Analysis using YACC
3	Semantic Analysis
4	Symbol Table and Intermediate Code Generation
5	Code Generation and Code Optimization

**Course Learning Outcomes:**

Upon successful completion of this course, the learner will be able to

- **CLO1** Understand the structure and components of a compiler and describe the various phases involved in the compilation process.
- **CLO2** Apply lexical analysis techniques, including recognizing tokens, specifying tokens using regular expressions, and utilizing the Lex lexical analyzer generator.
- **CLO3** Implement syntax analysis concepts, including context-free grammars, parsing techniques such as top-down and bottom-up parsing, and error recovery strategies.
- **CLO4** Utilize efficient data structures for symbol table organization to ensure seamless symbol lookup and management.
- **CLO5** Demonstrate competence in intermediate code generation, showcasing their ability to understand syntax tree variants, translate expressions into three-address code, and represent declarations, storage layout, and control flow in intermediate code structures.

**Evaluation Scheme:**

EC No.	Evaluation Components	Nature of Component	Duration	Weightage (%)	Date & Time	Venue
1	Midsem Exam	Open book*	90 minutes	30	29.03.24 FN	TBA
2	Lab Midsem Exam	Closed book	2hrs	20	20.03.24(34), 21.03.24(89), 22.03.24(34) (3 batches)	333 Lab
3	Lab Comprehensive Exam	Closed book	2hrs	10	TBA	333 Lab
4	Comprehensive Exam	Closed book	3 hrs	40	29.05.24 AN	TBA

\* Only prescribed text book(s) and hand-written notes are permitted

**Mapping of CLOs, PLOs, and CECs**

CLOs	PLOs	Evaluation Components (ECs)			
		EC1	EC2	EC3	EC4
CLO1	2, 4	✓	✓	✓	✓
CLO2	2, 3,4	✓	✓	✓	✓
CLO3	2,3,4	✓	✓	✓	✓
CLO4	5,6,8			✓	✓
CLO5	4,8			✓	✓

**Mid-sem Grading:**

Mid-sem grading will be displayed after midsem test whenever about 30% of evaluation components are completed.

**Note:** A student will be likely to get “NC”, if he / she doesn’t appear / appear for the sake of appearing for the evaluation components / scoring zero in pre-compre total / scoring zero in comprehensive examination.

**Makeup and Attendance policies:**

Make-ups are not given as a routine. It is solely dependent upon the genuineness of the circumstances under which a student fails to appear in a scheduled evaluation component. In such circumstances, prior permission should be obtained from the Instructor-in-Charge (I/C). Students with less than 60% of attendance will not be allowed to avail the make-ups. The decision of the I/C in the above matter will be final.

**Attendance:**

Every student is expected to be responsible for regularity of his/her attendance in class rooms and laboratories, to appear in scheduled tests and examinations and fulfill all other tasks assigned to him/her in every course. A student should have a minimum of 60% of attendance in a course to be eligible to appear for the Comprehensive Examination in that course. For the students under the purview of Academic Counseling Board (ACB), the Board shall prescribe the minimum attendance

requirement on a case-to-case basis. Attendance in the course will be a deciding factor in judging the seriousness of a student which may be directly / indirectly related to grading.

**General timings for consultation:**

Students can contact the course instructors in his / her chamber for consultation as follows

Dr. Elakkiya R: Tuesday 9<sup>th</sup> Hour

Dr. Angel Arul Jothi J: Tuesday 9<sup>th</sup> Hour

**General instructions:**

Students should come prepared for classes and carry the text book(s) or material(s) as prescribed by the Course Faculty to the class.

**Notices:**

All Notices regarding this course will be placed on CS Department notice board and Google classroom. Students are also informed to check their BITS email (regularly) for any communication regarding the course.

**Contact Details:**

1. Dr. R. Elakkiya, Dept of CS,  
Room No.282 Contact No: +9714-4200700 Ext. no: 314 e-mail: [elakkiya@dubai.bits-pilani.ac.in](mailto:elakkiya@dubai.bits-pilani.ac.in)
2. Dr. J. Angel Arul Jothi, Dept of CS,  
Room No: 231 Contact No: +9714-4200699 Ext. no: 158 e-mail: [angeljothi@dubai.bits-pilani.ac.in](mailto:angeljothi@dubai.bits-pilani.ac.in)

**Dr. R. Elakkiya**  
**Instructor-in-charge**