University of Asia Pacific (UAP)
Department of Computer Science and Engineering (CSE)

Course Outline

Program:	Computer Science and Engineering (CSE)
Course Title:	Compiler Design
Course Code:	CSE 429
Semester:	Spring 2025
Level:	**8**th Semester
Credit Hour:	3.0
Name & Designation of Teacher:	Sadia Jahangir Safa, Lecturer Jayonto Dutta Plabon, Lecturer
Office/Room:	5th Floor (RH)
Class Hours:	2:00 PM – 3:20 PM (Sunday) Section D 3:30 PM – 4:50 PM (Sunday) Section A 11:00 AM – 12.20 PM (Monday) Section A 5:00 PM – 6:20 PM (Tuesday) Section D
Consultation Hours:	2:00 PM – 03:30 PM (Tuesday) Section A 3:30 PM – 4:50 PM (Tuesday) Section D
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Rationale:	Compiler Design is a required course in the CSE program.
Pre-requisite (if any)**:**	N/A
Course Synopsis:	**Introduction to compilers**: Introductory concepts, types of compilers, applications, and phases of a compiler. **Lexical analysis**: Role of the lexical analyzer, regular expressions, regular languages. **Parsing**: Parser and its role, context 73 free grammars, bottom-up parsing; LR (O) parsing, SLR parsing, LR (I) parsing, LALR (1) parsing, classification of context-free grammars and language. **Syntax-directed translation**: syntax-directed definitions, attributes evaluation, Abstract syntax trees. **Type checking**: symbol Tables type checking, syntactic error recovery, Semantic checks for Inheritance, Subtyping and for overloading Generation of intermediate code. **Run-time organization**: runtime structures, storage strategies. **Intermediate code generation**: Intermediate languages, declarations, assignment statements.

Generation of intermediate code-translation of a Boolean expression, switch/case statements. Code optimization: Basic concepts of code optimization, principal sources of optimization, and Generation of optimized target code. **Advanced Topic**: control flow graphs, live-variable analysis allocation optimization register allocation by graph coloring Available expression analysis, Global common expression elimination, Dominators, Loops in control flow graphs, Defuse & use-def chains, Loop invariant, code-notion, Partial redundancy elimination, constant propagation, optimizing Object-oriented programs, copy propagation, phase ordering of optimization, Instruction Scheduling optimizations for memory hierarchies.

Course Objectives:

The objectives of this course are to

1. **Introduce** the key concepts in the areas of compiler design and different phases of a compiler.
2. **Demonstrate** the design and implementation of phases of the compiler and its use, and optimization techniques.
3. **Enable** students to gain skills in regular expressions, parsing, and various parsers like LL parser, and LR parser.
4. **Provide** knowledge on practical programming skills necessary for the construction of a compiler and also various tools for it.

Course Outcomes (CO) and their mapping with Program Outcomes (PO) and Teaching-Learning Assessment methods:

CO No.	CO Statements: Upon successful completion of the course, students should be able to:	Corresponding POs (Appendix-1)	Bloom's taxonomy domain/level (Appendix-2)	Delivery methods and activities	Assessment Tools (Tentative)
CO1	**Explain** terms related to compilers and its phases, grammars of parsers, the objective of the design & design techniques.	1	1/Understand	Live Lecture, PPT Presentation	Written Exam
CO2	**Develop** the concept of Finite Automata and Regular Expression in lexical analysis.	2	1/Apply	Live Lecture, PPT Presentation	Assignment, and Written Exam
CO3	**Examine** the role of Context-Free grammars in syntax analysis	3	1/Analyze	Live Lecture, PPT Presentation	Assignment, and Written Exam
CO4	**Analyze** the techniques of Intermediate Code Generation and Code Generation to design a compiler model	3	1/Analyze	Live Lecture, PPT Presentation	Written exam
CO5	**Apply** basic Code Optimization techniques and algorithms	2	1/Apply	Live Lecture, PPT Presentation	Written exam

Weighting COs with Assessment methods:

Assessment Type	% weight	CO1	CO2	CO3	CO4	CO5
Final Exam(Written exam)	50%					
Mid Term(Written exam)	20%	2	5	13		
CT	30%		10	10		
Total	100%					

Course Content Outline and mapping with COs

Weeks	Topics / Content	Course Outcome	Delivery methods and activities	Reading Materials
1	**Introductory concepts**, types of compilers, applications, phases of a compiler.	CO1	Lecture, multimedia	Book Reference, Slides, Class Notes
2-3	**Lexical analysis:** Role of the lexical analyzer, regular expressions, regular languages	CO1, CO2	Lecture, multimedia	Book Reference, Slides, Class Notes
4-5	**Lexical analysis:** DFA, NFA, Transition Diagram, Conversations among RE, DFA, NFA, Token, Lexeme, Pattern	CO1, CO2	Lecture, Problem Solving	Book Reference, Slides, Class Notes
6-7	**Parsing:** Parser and its role, context-free grammars, Left most derivation, Right most derivation, Parse tree, Ambiguity, Left recursion, Left Factoring, Types of Parsers, Top-down parser overview, Recursive descent parser, LL(1) Parser, String handling procedure	CO1, CO3	Lecture, multimedia, Problem Solving	Book Reference, Slides, Class Notes
Mid				
8-11	**Parsing:** Bottom-up parsing; LR (0) parsing, SLR parsing, LR (1) parsing, LALR (1) parsing, classification of context-free grammars and language.	CO3	Lecture, multimedia	Book Reference, Slides, Class Notes
12-13	**Intermediate code generation:** Intermediate languages, declarations, assignment statements, generation of intermediate code-translation of Boolean expression, switch/case statements.	CO4	Lecture, multimedia	Book Reference, Slides, Class Notes

13-14	**Advanced Topic:** Control flow graphs, live-variable analysis allocation optimization register allocation by graph coloring Available expression analysis.	CO4 CO5	Lecture, multimedia	Book Reference, Slides, Class Notes
Final Exam				

Minimum attendance: 70% class attendance is mandatory for a student in order to appear at the final examination.

Textbook:
1. Compilers: Principles, Techniques, and Tools – Alfred V. Aho, Ravi Sethi, Jeffrey D. Ullman. Second Edition.
2. Compiler Design and Construction (Electrical/computer science and engineering series) by Arthur B. Pyster.
3. Modern Compiler Design by D. Grune, H. Bal, C. Jacobs and K. Langendoen**.**

Grading System: As per the approved grading scale of the University of Asia Pacific (Appendix-3).

Special Instructions: **Assignment**: Assignment will be given throughout the semester. Copied assignments will be graded as zero. Late submission will result in a 50% deduction in the score.
Class Test: There will be no make-up quizzes.

Student's responsibilities: Students must come to the class prepared for the course material covered in the previous class (es).
They must submit their assignments on time.

Prepared by (Course Teacher)	**Checked by** (Chairman, PSAC committee)	**Approved by** (Head of the Department)
Sadia Jahangir Safa Jayonto Dutta Plabon		

Appendix-1:

Washington Accord Program Outcomes (PO) for engineering programs:

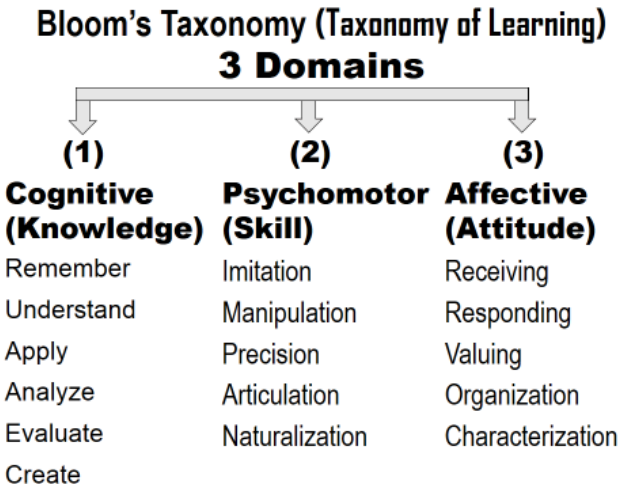
No.	PO	Differentiating Characteristic
1	Engineering Knowledge	Breadth and depth of education and type of knowledge, both theoretical and practical
2	Problem Analysis	Complexity of analysis
3	Design/ development of solutions	Breadth and uniqueness of engineering problems i.e. the extent to which problems are original and to which solutions have previously been identified or codified
4	Investigation	Breadth and depth of investigation and experimentation
5	Modern Tool Usage	Level of understanding of the appropriateness of the tool
6	The Engineer and Society	Level of knowledge and responsibility
7	Environment and Sustainability	Type of solutions.
8	Ethics	Understanding and level of practice
9	Individual and Team work	Role in and diversity of team
10	Communication	Level of communication according to type of activities performed
11	Project Management and Finance	Level of management required for differing types of activity
12	Lifelong learning	Preparation for and depth of Continuing learning.

Generic Skills (Detailed):

1. **Engineering Knowledge (T)** -Apply knowledge of mathematics, sciences, engineering fundamentals and manufacturing engineering to the solution of complex engineering problems;
2. **Problem Analysis (T)** – Identify, formulate, research relevant literature and analyze complex engineering problems, and reaching substantiated conclusions using first principles of mathematics, natural sciences and engineering sciences;
3. **Design/Development of Solutions (A)** –Design solutions, exhibiting innovativeness, for complex engineering problems and design systems, components or processes that meet specified needs with appropriate consideration for public health and safety, cultural, societal, economical, ethical, environmental and sustainability issues.
4. **Investigation (D)** Conduct investigation into complex problems, displaying creativeness, using research-based knowledge, and research methods including design of experiments, analysis and interpretation of data, and synthesis of information to provide valid conclusions;
5. **Modern Tool Usage (A & D)** -Create, select and apply appropriate techniques, resources, and modern engineering and IT tools, including prediction and modelling, to complex engineering activities, with an understanding of the limitations;
6. **The Engineer and Society (ESSE)** -Apply reasoning based on contextual knowledge to assess societal, health, safety, legal, cultural, contemporary issues, and the consequent responsibilities relevant to professional engineering practices.
7. **Environment and Sustainability (ESSE)** -Understand the impact of professional engineering solutions in societal, global, and environmental contexts and demonstrate knowledge of and need for sustainable development;
8. **Ethics (ESSE)** –Apply professional ethics with Islamic values and commit to responsibilities and norms of professional engineering code of practices.
9. **Communication (S)** -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;

10. **Individual and Team Work (S)** -Function effectively as an individual, and as a member or leader in diverse teams and in multi-disciplinary settings.
11. **Life Long Learning (S)** -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.
12. **Project Management and Finance (S)** -Demonstrate knowledge and understanding of engineering management and financial principles and apply these to one's own work, as a member and/or leader in a team, to manage projects in multidisciplinary settings, and identify opportunities of entrepreneurship.

Appendix-2



Appendix-3
UAP Grading Policy:

Numeric Grade	Letter Grade	Grade Point
80% and above	A+	4.00
75% to less than 80%	A	3.75
70% to less than 75%	A-	3.50
65% to less than 70%	B+	3.25
60% to less than 65%	B	3.00
55% to less than 60%	B-	2.75
50% to less than 55%	C+	2.50
45% to less than 50%	C	2.25
40% to less than 45%	D	2.00
Less than 40%	F	0.00