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**UNIVERSITY OF PETROLEUM & ENERGY STUDIES**

**College of Engineering Studies**

**Dehradun**

**COURSE PLAN**

Program : B. Tech- CSE with DEVOPS

Course : Compiler Design

Subject Code : CSEG 326

No. of credits : 3

Semester : V

Session : AUG 2020- DEC 2020

Batch : 2018-22

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**Approved By**

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**COURSE PLAN**

1. **PREREQUISITE:**
   1. Basic Arithmetic
   2. Data Structures
   3. Simple Graph Algorithms
   4. Knowledge of Automata Theory
   5. Computer Architecture
2. **B1. PROGRAM OUTCOMES (POs)**

**PO1: Engineering knowledge:** Apply the knowledge of mathematics, science, engineering fundamentals, and an engineering specialization to the solution of complex engineering problems.

**PO2: Problem analysis:** Identify, formulate, review research literature, and analyze complex engineering problems reaching substantiated conclusions using first principles of mathematics, natural sciences, and engineering sciences.

**PO3: 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.

**PO4: 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.

**PO5: 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.

**PO6: The engineer 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.

**PO7: 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.

**PO8: Ethics:** Apply ethical principles and commit to professional ethics and responsibilities and norms of the engineering practice.

**PO9: Individual and team work:** Function effectively as an individual, and as a member or leader in diverse teams, and in multidisciplinary settings.

**PO10: 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.

**PO11: 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.

**PO12: 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.

**B2. Program Specific Outcomes (PSOs)**

**PSO1.** Perform system and application programming using computer system concepts, concepts of Data Structures, algorithm development, problem solving and optimizing techniques

**PSO2.** Apply software development and project management methodologies using concepts of front-end and back-end development and emerging technologies and platforms.

**PSO3.** Ability to develop the understanding of quantitative modeling and data analysis techniques and to apply these to real world business problems, communicate findings, and effectively present results for improved decision-making.

1. **OBJECTIVES OF COURSE:**

The objectives of this course are to

* To introduce the major concept areas of language translation and compiler design.
* To enrich the knowledge in various phases of compiler ant its use, code optimization techniques, machine code generation, and use of symbol table.
* To extend the knowledge of parser by parsing LL parser and LR parser.
* To provide practical programming skills necessary for constructing a compiler.

1. **COURSE OUTCOMES (CO) FOR COMPILER DESIGN:**

At the end of this course student should be able to

* CO1. Comprehend the different phases of Compiler and specifying different types of tokens by lexical analyzer, and also be able to use the lexical tool viz. LEX
* CO2. Construct various efficient parsers viz. LL, SLR, CLR and LALR parse table and also be able to use the syntax analysis tool viz. YACC
* CO3. Explore syntax-directed translations
* CO4. Deal with different techniques of symbol table organization
* CO5. Learn the new code optimization techniques to improve the performance of a program in terms of speed & space.

**Table: Correlation of POs v/s COs**

|  |  |  |  |  |  |  |  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- | --- |
| PO/CO | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
| CO1 | 1 |  |  |  | 1 |  |  | 1 |  |  |  |  |
| CO2 |  |  |  |  |  | 1 |  |  |  | 1 |  |  |
| CO3 |  | 2 |  |  | 1 |  |  |  |  |  |  | 1 |
| CO4 |  |  |  |  |  | 1 |  |  |  | 1 |  |  |
| CO5 |  |  |  |  |  |  |  | 1 |  |  |  |  |

1. WEAK 2. MODERATE 3. STRONG
2. **COURSE OUTLINE:**

|  |  |  |
| --- | --- | --- |
| **S. No.** | **Units** | **Contents** |
| 1 | Unit – I | INTRODUCTION |
| 2 | Unit – II | BASIC PARSING TECHNIQUE |
| 3 | Unit – III | SYNTAX-DIRECTED TRANSLATION |
| 4 | Unit – IV | SYMBOL TABLES |
| 5 | Unit – V | INTRODUCTION TO CODE OPTIMIZATION |

1. **PEDAGOGY:**
2. Lectures using Board
3. Presentations & Video Lectures
4. Discussions & Tutorials
5. Assessments (Class Test, Quiz, Assignments)
6. **COURSE COMPLETION PLAN:**

|  |  |
| --- | --- |
| Total Class sessions | 36 |
| Total Quizzes | 02 |
| Total Test | 02 |
| Total Assignment | 02 |

One Session=60 minutes

1. **EVALUATION & GRADING:**

Students will be evaluated based on the following 3 stages.

1. Internal Assessment - 30%
2. Mid-term Examination - 20%
3. End term Examination - 50%

**H1. INTERNAL ASSESSMENT: WEIGHTAGE – 30%**

Internal Assessment shall be done based on the following:

|  |  |  |
| --- | --- | --- |
| **Assessment** | **Points** | **Percentage** |
| Quiz (After completion of session 7 & 33 ) | 2 Quiz @ 15 points each. | 30% |
| Assignments (After end of session 12 &26 ) | 2 Assignments @ 10 points each. | 20% |
| Test (After completion of session 11& 27) | 2 Test @ 20 points each. | 40% |
| Conduct of the student (General discipline) | @10 points. | 10% |
| Total | 100 points | 100% |

**H2. Internal Assessment Record Sheet (including Mid Term Examination marks*)*** will be displayed online at the end of semester i.e. last week of regular classroom teaching.

**H3. CLASS TESTS/QUIZZES:** Two Class Tests based on descriptive type theoretical & numerical questions will be conducted as detailed above. Two Quizzes based on short answer type questions will be held as detailed above. *The marks obtained by the students will be displayed a week before the start of Mid Term and End Term Examinations respectively.*

**H4. ASSIGNMENTS:** There will be two assignments before Mid Term and End Term Examination. Two week time (approx.) would be given to submit the Assignment. Those who fail to submit the assignments by the due date shall lose their marks.

**H5. GENERAL DISCIPLINE:** Based on student’s regularity, punctuality, sincerity and behavior in the class. The marks obtained by the students will be displayed at the end of semester.

**H6. MID TERM EXAMINATION: WEIGHTAGE – 20%**

Mid Term examination shall be Two Hours duration and shall be a combination of Short and Long theory Questions. Date of showing Mid Term Examination Answer Sheets: Within a week after completion of mid semester examination.

**H7. END TERM EXAMINATION: WEIGHTAGE – 50%**

End Term Examination shall be Three Hours duration and shall be a combination of Short and Long theory/numerical Questions.

**H8. GRADING:**

The overall marks obtained at the end of the semester comprising all the above three mentioned shall be converted to a grade.

1. **DETAILED SESSION PLAN:**

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| **Module /Session** | **Big Ideas/ Topics** | **Course Outcomes Addressed** | **Required Learning Resources (including media)** | **Pedagogy/ Discussion/ Postings** | **Assessment** |
| **Module 1** | **Introduction** | | | | |
| 1 | Introduction to Course and Listing the Text & Reference Books | CO1 | Suggested Reading | Lecture |  |
| 2 | Compiler Structure, Phases and Passes, Bootstrapping | CO1 | Suggested Reading | Lecture |  |
| 3 | Compiler Structure, Phases and Passes, Bootstrapping (Contd.) | CO1 | Suggested Reading | Lecture |  |
| 4 | Introduction to Lexical Analysis | CO1 | Suggested Reading | Lecture |  |
| 5 | Application of Lexical Analysis | CO1 | Suggested Reading | Lecture |  |
| 6 | Implementation & Generation of Lexical Analysis | CO1 | Suggested Reading | Lecture |  |
| 7 | Lex Compiler | CO1 | Suggested Reading | Lecture | Quiz 1 |
| **Module 2** | **BASIC PARSING TECHNIQUES** | | | | |
| 8 | Introduction to Parsing- Parse Tree, Derivation, & Ambiguity | CO1 | Suggested Reading | Lecture |  |
| 9 | Top Down Parsing | CO2 | Suggested Reading | Lecture |  |
| 10 | Computation of FIRST & FOLLOW | CO2 | Suggested Reading | Lecture |  |
| 11 | LL Parsers | CO1 & CO2 | Suggested Reading | Discussion | Discussion & Class Test-1 |
| 12 | Predictive Parser | CO2 | Suggested Reading | Lecture | Assignment 1 release |
| 13 | Shift Reduce Parsing, Handle, and Handle Pruning | CO2 | Suggested Reading | Lecture |  |
| 14 | Operator Precedence Parsing | CO2 | Suggested Reading | Lecture |  |
| 15 | LR Parsing | CO2 | Suggested Reading | Lecture |  |
| 16 | SLR Parser | CO2 | Suggested Reading | Lecture |  |
| 17 | Canonical LR and LALR Parsers | CO2 | Suggested Reading | Lecture |  |
| 18 | Introduction to YACC | CO2 | Suggested Reading | Lecture | Assignment 1 Submission |
| 19 | Application of YACC | CO2 | Suggested Reading | Discussion& Tutorial |  |
| **Module 3** | **SYNTAX-DIRECTED TRANSLATION** | | | | |
| 20 | Introduction to Syntax-Directed Translation Schemes | CO3 | Suggested Reading | Lecture |  |
| 21 | Implementation of syntax directed translation | CO3 | Suggested Reading | Lecture |  |
| 22 | Intermediate Code, Postfix Notation, Parse Trees & Syntax Trees | CO3 | Suggested Reading | Lecture |  |
| 23 | Three Address Code, Quadruple & Triples | CO3 | Suggested Reading | Lecture |  |
| 24 | Translation of Expressions | CO3 | Suggested Reading | Readings/ brief video/ Presentations |  |
| 25 | Translation of Control Flow Statements | CO3 | Suggested Reading | Lecture |  |
| 26 | More About Translation: Array References in Arithmetic Expressions, Procedure Calls, etc. | CO3 | Suggested Reading | Lecture | Assignment-2 release |
| **Module 4** | **SYMBOL TABLE** | | | | |
| 27 | Data Structure for Symbol Table | CO1/CO2/CO3 | Suggested Reading | Discussion | Discussion & Class Test-2 |
| 28 | Implementation of Simple Stack Allocation Scheme | CO4 | Suggested Reading | Lecture |  |
| 29 | Storage Allocation in Block Structured Language | CO4 | Suggested Reading | Lecture |  |
| 30 | Error Detection & Recovery | CO4 | Suggested Reading | Lecture |  |
| 31 | Lexical & Syntactic Phase Errors | CO4 | Suggested Reading | Lecture |  |
| 32 | Problems based on storage allocation | CO4 | Suggested Reading | Discussion | Assignment-2 submission |
| **Module 5** | **INTRODUCTION TO CODE OPTIMIZATION** | | | | |  |
| 33 | Introduction to Code Generation & Need of Code Optimization | CO5 | Suggested Reading | Lecture | Discussion & Quiz 2 |
| 34 | Optimization of Basic Block- DAG Representation | CO5 | Suggested Reading | Lecture |  |
| 35 | Value Number & Algebraic Laws & Loop Optimization | CO5 | Suggested Reading | Lecture |  |
| 36 | Global Data Flow Analysis | CO5 | Suggested Reading | Lecture |  |

1. **SUGGESTED READINGS:**

**Text Book:**

Robin Hunter, “The Essence of Compiler”, Pearson Publication

**Reference book:**

Alfred V. Aho, Ravi Sethi Jeffrey D. Ullman, “Compilers- Principles, Techniques, and

Tools”, Pearson Education Asia

1. **GUIDELINES:**

***Cell Phones and other Electronic Communication Devices*:** Cell phones and other electronic communication devices (such as Blackberries/Laptops) are not permitted in classes during Tests or the Mid/Final Examination. Such devices MUST be turned off in the class room.

***E-Mail and online learning tool:*** Each student in the class should have an e-mail id and a password to access the ICOS/LMS system regularly. Regularly, important information – Date of conducting class tests, guest lectures, via online learning tool. The best way to arrange meetings with us or ask specific questions is by email and prior appointment. All the assignments preferably should be uploaded on online learning tool. Various research papers/reference material will be mailed/uploaded on online learning platform time to time.

***Attendance:*** Students are required to have **minimum attendance of 75%** in each subject. Students with less than said percentage shall **NOT** be allowed to appear in the end semester examination.

***Passing criterion:*** .Student has to secure minimum 35% marks of the full marks individually in both the ‘End-Semester examination’ and ‘Total Marks’ in order to pass in this course.

**Sample format for Indirect Assessment of Course outcomes**

|  |
| --- |
| NAME: |
| ENROLLMENT NO: |
| SAP ID: |
| COURSE: |
| PROGRAM: |

Please rate the following aspects of course outcomes of Compiler Design.

Use the scale 1-4\*

|  |  |  |  |  |  |
| --- | --- | --- | --- | --- | --- |
| S. No. | Course Outcomes | 1 | 2 | 3 | 4 |
| 1 | CO1. Comprehend the different phases of Compiler and specifying different types of tokens by lexical analyzer, and also be able to use the lexical tool viz. LEX |  |  |  |  |
| 2 | CO2. Designing of various efficient parsers viz. LL, SLR, CLR and LALR parse table and also be able to use the syntax analysis tool viz. YACC |  |  |  |  |
| 3 | CO3. Explore syntax-directed translations |  |  |  |  |
| 4 | CO4. Deal with different techniques of symbol table organization. |  |  |  |  |
| 5 | CO5. Learn the new code optimization techniques to improve the performance of a program in terms of speed & space. |  |  |  |  |

3

Below Average

Good

1

**\***

Very Good

Average

4

2