| CSL411 | COMPILER LAB | CATEGORY | L | T | P | CREDIT |
|---|---|---|---|---|---|---|
| | | PCC | 0 | 0 | 3 | 2 |

**Preamble:** This course aims to offer students hands-on experience on compiler design concepts. Students will be able to familiarize with tools such as LEX and YACC and automate different phases of a compiler. This course helps the learners to enhance the capability to design and implement a compiler.

**Prerequisite: A s**ound knowledge in C programming, Data Structures, Formal languages and Automata Theory and Compiler design.

**Course Outcomes:** After the completion of the course the student will be able to

| | |
|---|---|
| **CO 1** | Implement lexical analyzer using the tool LEX. **(Cognitive Knowledge Level: Apply)** |
| **CO 2** | Implement Syntax analyzer using the tool YACC. **(Cognitive Knowledge Level: Apply)** |
| **CO 3** | Design NFA and DFA for a problem and write programs to perform operations on it. **(Cognitive Knowledge Level: Apply)** |
| **CO 4** | Design and Implement Top-Down parsers. **(Cognitive Knowledge Level: Apply)** |
| **CO 5** | Design and Implement Bottom-Up parsers. **(Cognitive Knowledge Level: Apply)** |
| **CO 6** | Implement intermediate code for expressions. **(Cognitive Knowledge Level: Apply)** |

**Mapping of course outcomes with program 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 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO 1** | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | | ✓ | | ✓ |
| **CO 2** | ✓ | ✓ | ✓ | ✓ | ✓ | | | ✓ | | ✓ | | ✓ |
| **CO 3** | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | ✓ | | ✓ |
| **CO 4** | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | ✓ | | ✓ |
| **CO 5** | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | ✓ | | ✓ |
| **CO 6** | ✓ | ✓ | ✓ | ✓ | | | | ✓ | | ✓ | | ✓ |

**Assessment Pattern**

| Bloom's Category | Continuous Assessment Test % | End Semester Examination % |
|---|---|---|
| **Remember** | 20 | 20 |
| **Understand** | 20 | 20 |
| **Apply** | 60 | 60 |
| **Analyze** | | |
| **Evaluate** | | |
| **Create** | | |

**Mark distribution**

| Total Marks | CIE | ESE | ESE Duration |
|---|---|---|---|
| 150 | 75 | 75 | 3 hours |

**Continuous Internal Evaluation Pattern:**

Attendance : 15 marks

Continuous Evaluation in Lab : 30 marks

Continuous Assessment Test : 15 marks

Viva-voce : 15 marks

**Internal Examination Pattern:** The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks which will be converted out of 15 while calculating Internal Evaluation marks.

**End Semester Examination Pattern:** The marks will be distributed as Algorithm 30 marks, Program 20 marks, Output 20 marks and Viva 30 marks. Total 100 marks will be converted out of 75 for End Semester Examination.

**Operating System to Use in Lab** **:** Linux

**Compiler/Software to Use in Lab** **:** gcc, lex, yacc

**Programming Language to Use in Lab** **:** Ansi C

**Fair Lab Record**:

All Students attending the Compiler Lab should have a Fair Record. The fair record should be produced in the University Lab Examination. Every experiment conducted in the lab should be noted in the fair record. For every experiment in the fair record the right hand page should contain Experiment Heading, Experiment Number, Date of Experiment, Aim of Experiment, Details of Experiment including algorithm and Result of Experiment. The left hand page should contain a print out of the code used for the experiment and sample output obtained for a set of input.

## SYLLABUS

1. Implementation of lexical analyzer using the tool LEX.
2. Implementation of Syntax analyzer using the tool YACC.
3. Application problems using NFA and DFA.
4. Implement Top-Down Parser.
5. Implement Bottom-up parser.
6. Simulation of code optimization Techniques.
7. Implement Intermediate code generation for simple expressions.
8. Implement the back end of the compiler.

## PRACTICE QUESTIONS

**List of Exercises/Experiments**:

1. Design and implement a lexical analyzer using C language to recognize all valid tokens in the input program. The lexical analyzer should ignore redundant spaces, tabs and newlines. It should also ignore comments.
2. Implement a Lexical Analyzer for a given program using Lex Tool.
3. Write a lex program to display the number of lines, words and characters in an input text.
4. Write a LEX Program to convert the substring *abc* to *ABC* from the given input string.
5. Write a lex program to find out total number of vowels and consonants from the given input sting.
6. Generate a YACC specification to recognize a valid arithmetic expression that uses operators +, – , *,/ and parenthesis.

7. Generate a YACC specification to recognize a valid identifier which starts with a letter followed by any number of letters or digits.
8. Implementation of Calculator using LEX and YACC
9. Convert the BNF rules into YACC form and write code to generate abstract syntax tree.
10. Write a program to find ε – closure of all states of any given NFA with ε transition.
11. Write a program to convert NFA with ε transition to NFA without ε transition.
12. Write a program to convert NFA to DFA.
13. Write a program to minimize any given DFA.
14. Write a program to find First and Follow of any given grammar.
15. Design and implement a recursive descent parser for a given grammar.
16. Construct a Shift Reduce Parser for a given language.
17. Write a program to perform constant propagation.
18. Implement Intermediate code generation for simple expressions.
19. Implement the back end of the compiler which takes the three address code and produces the 8086 assembly language instructions that can be assembled and run using an 8086 assembler. The target assembly instructions can be simple move, add, sub, jump etc.

| CSQ413 | SEMINAR | CATEGORY | L | T | P | CREDIT |
|---|---|---|---|---|---|---|
| | | PWS | 0 | 0 | 3 | 2 |

**Preamble:** The course 'Seminar' is intended to enable a B.Tech graduate to read, understand, present and prepare report about an academic document. The learner shall search in the literature including peer reviewed journals, conference, books, project reports etc., and identify an appropriate paper/thesis/report in her/his area of interest, in consultation with her/his seminar guide. This course can help the learner to experience how a presentation can be made about a selected academic document and also empower her/him to prepare a technical report.



**Course Objectives:**

- To do literature survey in a selected area ofstudy.
- To understand an academic document from the literate and to give a presentation about it.
- To prepare a technical report.

**Course Outcomes [COs] :** After successful completion of the course, the students will be able to:

| | |
|---|---|
| CO1 | Identify academic documents from the literature which are related to her/his areas of interest (Cognitive knowledge level: **Apply**). |
| CO2 | Read and apprehend an academic document from the literature which is related to her/ his areas of interest (Cognitive knowledge level: **Analyze**). |
| CO3 | Prepare a presentation about an academic document (Cognitive knowledge level: **Create**). |
| CO4 | Give a presentation about an academic document (Cognitive knowledge level: **Apply**). |
| CO5 | Prepare a technical report (Cognitive knowledge level: **Create**). |

**Mapping of course outcomes with program outcomes:**

| | PO1 | PO2 | PO3 | PO4 | PO5 | PO6 | PO7 | PO8 | PO9 | PO10 | PO11 | PO12 |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CO1** | 2 | 2 | 1 | 1 | | 2 | 1 | | | | | 3 |
| **CO2** | 3 | 3 | 2 | 3 | | 2 | 1 | | | | | 3 |
| **CO3** | 3 | 2 | | | 3 | | | 1 | | 2 | | 3 |
| **CO4** | 3 | | | | 2 | | | 1 | | 3 | | 3 |
| **CO5** | 3 | 3 | 3 | 3 | 2 | 2 | | 2 | | 3 | | 3 |

| Abstract POs defined by National Board of Accreditation | | | |
|---|---|---|---|
| **PO#** | **Broad PO** | **PO#** | **Broad PO** |
| PO1 | Engineering Knowledge | PO7 | Environment and Sustainability |
| PO2 | Problem Analysis | PO8 | Ethics |
| PO3 | Design/Development of solutions | PO9 | Individual and team work |
| PO4 | Conduct investigations of complex problems | PO10 | Communication |
| PO5 | Modern tool usage | PO11 | Project Management and Finance |
| PO6 | The Engineer and Society | PO12 | Life long learning |

**General Guidelines**

- The Department shall form an Internal Evaluation Committee (IEC) for the seminar with academic coordinator for that program as the Chairperson/Chairman and seminar coordinator & seminar guide as members. During the seminar presentation of a student, all members of IEC shall be present.
- Formation of IEC and guide allotment shall be completed within a week after the University examination (or last working day) of the previous semester.
- Guide shall provide required input to their students regarding the selection of topic/ paper.
- Choosing a seminar topic: The topic for a UG seminar should be current and broad based rather than a very specific research work. It's advisable to choose a topic for the Seminar to be closely linked to the final year project area. Every member of the project team could choose or be assigned Seminar topics that covers various aspects linked to the Project area.
- A topic/paper relevant to the discipline shall be selected by the student during the semester break.
- Topic/Paper shall be finalized in the first week of the semester and shall be submitted to the IEC.
- The IEC shall approve the selected topic/paper by the second week of the semester.
- Accurate references from genuine peer reviewed published material to be given in the report and to be verified.

## Evaluation pattern

**Total marks: 100, only CIE, minimum required to pass 50**

**Seminar Guide:** 20 marks (Background Knowledge – 10 (The guide shall give deserving marks for a candidate based on the candidate's background knowledge about the topic selected), Relevance of the paper/topic selected – 10).

**Seminar Coordinator:** 20 marks (Seminar Diary – 10 (Each student shall maintain a seminar diary and the guide shall monitor the progress of the seminar work on a weekly basis and shall approve the entries in the seminar diary during the weekly meeting with the student), Attendance – 10).

**Presentation:** 40 marks to be awarded by the IEC (Clarity of presentation – 10, Interactions – 10 (to be based on the candidate's ability to answer questions during the interactive session of her/his presentation), Overall participation – 10 (to be given based on her/his involvement during interactive sessions of presentations by other students), Quality of the slides – 10).

**Report:** 20 marks to be awarded by the IEC (check for technical content, overall quality, templates followed, adequacy of references etc.).