

FR. Conceicao Rodrigues College Of Engineering

Father Agnel Ashram, Bandstand, Bandra-west, Mumbai-50

Department of Computer Engineering

T.E. (Computer) (semester VI)

(2020-2021)

Course Outcomes & Assessment Plan

Subject: System Programming Compiler Construction (CPC601)

Credits-5

Syllabus:

1. Introduction to System Software

Concept of System Software, Goals of system software's, system program and system programming, Introduction to various system programs such as Assembler, Macro processor, Loader, Linker, Compiler, Interpreter, Device Drivers, Operating system, Editors, Debuggers

2. Assemblers

Elements of Assembly Language programming, Assembly scheme, pass structure of assembler, Assembler Design: Two pass assembler Design and single pass Assembler Design for Hypothetical / X86 family processor, data structures used.

3. Macros & Macro processors

Introduction, Macro definition and call, Features of Macro facility: Simple, parameterized, conditional and nested. Design of single pass macro processor, data structures used

4. Loaders and Linkers

Introduction, functions of loaders, Relocation and Linking concept, Different loading schemes: Relocating loader, Direct Linking Loader, Dynamic linking and loading.

5. Compilers: Analysis Phase

Introduction to compilers, Phases of compilers: **Lexical Analysis**- Role of Finite State Automata in Lexical Analysis, Design of Lexical analyser, data structures used . **Syntax Analysis**- Role of Context Free Grammar in Syntax analysis, Types of Parsers: Top down parser- LL(1), Bottom up parser- Operator precedence parser, SLR **Semantic Analysis**, Syntax directed definitions.

6. Compilers: Synthesis Phase

Intermediate Code Generation: Types of Intermediate codes: Syntax tree, Postfix notation, Three address codes: Triples and Quadruples. **Code Optimization:** Need and sources of optimization, Code optimization techniques: Machine Dependent and Machine Independent. **Code Generation:** Issues in the design of code generator, code generation algorithm. Basic block and flow graph.

Text Books:

1. D. M Dhamdhare: Systems programming, Tata McGraw Hill
2. A. V. Aho, R. Shethi, Monica Lam , J.D. Ulman : Compilers Principles, Techniques and Tools , Pearson Education , Second Edition.
3. J. J. Donovan: Systems Programming Tata McGraw Hill Publishing Company

Reference Books:

1. Lex and Yacc , 2nd Edition
2. Compiler construction D,M.Dhamdhare second edition MACMILLAM.
3. Compiler construction : principles and practices , Kenneth C.Louden ,CENGAGE Learning
4. System software : An introduction to system programming , Leland L. Beck, Pearson

Assessment:**Internal Assessment:**

Assessment consists of two class tests of 20 marks each. The first class test is to be conducted when approx. 40% syllabus is completed and second class test when additional 40% syllabus is completed. Duration of each test shall be one hour.

End Semester Theory Examination:

1. Question paper will comprise of 6 questions, each carrying 20 marks.
 2. The students need to solve total 4 questions.
 3. Question No.1 will be compulsory and based on entire syllabus.
- Remaining question (Q.2 to Q.6) will be selected from all the modules

Online resources:

NPTEL Links uploaded on moodle

Course objectives:

1. To understand the role and functioning of various system programs over application program.
2. To understand basic concepts and designing of assembler, Macro processor and role of static and dynamic loaders and linkers.
3. To understand the need to follow the syntax in writing an application program and to learn the how the analysis phase of compiler is designed to understand the programmer's requirements without ambiguity.
4. To synthesize the analysis phase outcomes to produce the object code that is efficient in terms of space and execution time.

Course Outcome	After successful completion of the course students should be able to
CO1	Design basic two pass Assembler (B2-Understanding)
CO2	Design basic two pass Macro Pre-processor and Loader (B2-Understanding)
CO3	Acquire knowledge on various phases of Compiler. (B2-Understanding)
CO4	Design various parsing techniques (B2-Understanding)

Relationship of course outcomes with program outcomes: Indicate 1 (low importance), 2 (Moderate Importance) or 3 (High Importance) in respective mapping cell.

	PO1 (Engg Know)	PO2 (Ana)	PO3 (Design)	PO4 (investiga)	PO5 (tools)	PO6 (eng Soc)	PO7 (Env)	PO8 (Eth)	PO9 (ind Team)	PO10 (comm.)	PO11 (PM)	PO12 (life Long)
CPC601.1	3	2	3									
CPC601.2	3	2	3									
CPC601.3	3	2	1		1							
CPC601.4	3	2	3		1							
Course To PO												

CO	PSO1	PSO2
CPC601.1	2	
CPC601.2	2	
CPC601.3	2	
CPC601.4	2	
Course to PSO		

Justification

PO1: This subject all COs are mapped to PO1 because engineering graduates will be able to apply the knowledge of System Programming to solve complex engineering problems.

PO2: This subject all COs are mapped to PO2 because the students analyze the given problem statement

PO3: This subject all COs are mapped to PO3 because the students design the various system soft wares.

PO5: CO601.3 and CO601.4 are mapped to PO5 because the students use the tools like Lex and Yacc to implement phases of compilers.

PSO1: All COs are mapped to PSO1 because the graduates will be able to apply knowledge of system program to simulate the real world problem.

CO Assessment Tools:

CPC601.1: Direct Methods(80%): Test1, Assignment, Lab, UniExamTh , UniExamPr

$$CO1dm = 0.2T1 + 0.2assign + 0.2Lab + 0.2UTh + 0.2UTPr$$

Indirect Methods(20%): Course exit survey

$$CO1idm$$

$$CSC302.1 = 0.8 * CO1dm + 0.2 * CO1idm$$

Direct Methods	Weightage	Target	Date	Marks
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Test 1	0.2	65% students will score minimum 65% marks (i.e. 3 or more out of 5)	08-03-21	10M
Assignment	0.2	65% students will score minimum 70% marks (i.e. 7 or more out of 10)	01-03-21	10M
Lab	0.2	70% students will score minimum 70% marks (i.e. 7 or more out of 10)	Expt 1	10M
Uni Theory exam	0.2	60% students will score minimum 70% marks (i.e. 52 or more out of 80)		80M
Uni. Practical Exam	0.2	65% students will score minimum 70% marks (i.e. 17.5 or more out of 25)		25M

CPC601.2: Direct Methods(80%): Test1,2 Quiz Lab Assignment UniExamTh , UniExamPr

$$CO2dm = 0.2T1 + 0.2Q + 0.2Lab + 0.2UTh + 0.2UTPr$$

InDirect Methods(20%): Course exit survey

$$CO2idm$$

$$CSC302.2 = 0.8 * CO2dm + 0.2 * CO2idm$$

Direct Methods	Weightage	Target	Date	Marks
Test 1 And Test2	0.2	60% students will score minimum 65% marks (i.e. 3 or more out of 5)	08-03-21	10M
Quiz	0.2	60% students will score minimum 70% marks (i.e. 14 or more out of 20)	07-03-21	10M
Lab	0.2	65% students will score minimum 70% marks (i.e. 14 or more out of 20)	Expt 2,3	10M
Uni Theory exam	0.2	60% students will score minimum 70% marks (i.e. 58 or more out of 80)		80M
Uni. Practical Exam	0.2	65% students will score minimum 70% marks (i.e. 17.5 or more out of 25)		25M

CPC601.3: Direct Methods(80%): Test2 Quiz Lab UniExamTh

$$CO3dm = 0.1T2 + 0.2Q + 0.3Lab + 0.2UTh + 0.2UTPr$$

InDirect Methods(20%): Course exit survey

$$CO3idm$$

$$CSC302.3 = 0.8 * CO3dm + 0.2 * CO3idm$$

Direct Methods	Weightage	Target	Date	Marks
Test 2	0.1	60% students will score minimum 65% marks (i.e. 6.5 or more out of 10)	4 th Week of April	Q-3 (10M)
Quiz2	0.2	60% students will score minimum 70%	25-03-21	20M

		marks (i.6. 14 or more out of 20)		
Lab	0.3	70% students will score minimum 70% marks (i.6. 14 or more out of 20)	Expt 5-8	10M
Uni Theory exam	0.2	60% students will score minimum 65% marks (i.6. 52 or more out of 80)		80M
Uni. Practical Exam	0.2	65% students will score minimum 70% marks (i.6. 17.5 or more out of 25)		25M

CPC601.4: Direct Methods(80%): Test2 Lab Assignment UniExamTh

$$CO4dm = 0.2T2 + 0.3Lab + 0.1A + 0.2UTh + 0.2UTPr$$

InDirect Methods(20%): Course exit survey

$$CO4idm$$

$$CSC302.4 = 0.8 * CO4dm + 0.2 * CO4idm$$

Direct Methods	Weightage	Target	Date	Marks
Test 2	0.2	60% students will score minimum 65% marks (i.6. 6.5 or more out of 10)	4 th Week of April	Q-2 (10M)
Lab	0.3	65% students will score minimum 70% marks (i.6. 14 or more out of 20)	Expt 6 & 7	10M
Assignment	0.1	65% students will score minimum 70% marks (i.6. 14 or more out of 20)	26-03-21	20M
Uni Theory exam	0.2	60% students will score minimum 65% marks (i.6. 52 or more out of 80)		80M
Uni. Practical Exam	0.2	60% students will score minimum 70% marks (i.6. 17.5 or more out of 25)		25M

Content beyond syllabus:

Case study on Natural Language processing – Students will understand to apply the knowledge of phases of compiler to NLP.

Course Outcomes Target:

Upon completion of this course students will be able to:

CPC601.1: Design basic two pass Assembler

Target level: 2.5

CPC601.2 Design basic two pass Macro Pre-processor and Loader

Target level: 2.5

CPC601.3: Acquire knowledge on various phases of Compiler

Target level: 2.5

CPC601.4: Design various parsing techniques

Target level: 2.5

RUBRICS for the SPCC Lab Experiments

1	Time Line (2)	N.A	Two sessions late (0)	One session late (1)	Early or on time (2)
2	Output (3)	Practical not performed. (0)	Practical performed but failed to show output due to some error. (1)	Output shown but not as expected (Partial output) (2)	Expected output shown (3)
3	Code optimization (3)	Practical not performed (0)	Code is unstructured and difficult to understand(1)	The code is structured (2)	The code is structured and optimized (3)
4	Knowledge about the topic (2)	N.A	Not able to answer any question (0)	Able to answer few questions (1)	Answered all the questions with relevant explanation (2)

Rubrics for the Assignment :

Indicator	Very Poor	Poor	Average	Good	Excellent
On time Submission (2)	Assignment not	More than two session	Two sessions late (1)	One session late	Early or on time

	submitted (0)	late (0.5)		(1.5)	(2)
Organization (2)	N/A	Very poor readability and not structured (0.5)	Poor readability and somewhat structured (1)	Readable with one or two mistakes and structured (1.5)	Very well written and structured without any mistakes (2)
Level of content (4)	N/A	Major points are omitted / addressed minimally (1)	All major topics are covered, the information is accurate. (2)	Most major and some minor criteria are included. Information is Accurate (3)	All major and minor criteria are covered and are accurate. (4)
Depth and breadth of discussion (2)	N/A	None in evidence; superficial at most (0.5)	Minor points/information may be missing and discussion is minimal (1)	Discussion centers on some of the points and covers them adequately (1.5)	Information is presented in depth and is accurate (2)

Assignment: 1

Sub: SPCC

Topic: Assembler

Date: 1nd Week of Feb

- 1. DESIGN PASS1 OF TWO PASS ASSEMBLER FOR GIVEN INPUT SOURCE PROGRAM**
- 2. DESIGN PASS2 OF TWO PASS ASSEMBLER FOR GIVEN INPUT SOURCE PROGRAM**

Note: Write input files and output file generated

INPUT:

PG1 START 0

USING *,15

L 1,FIVE

A 1,FOUR
ST 1,TEMP
SR 2,2
AR 1,2
FIVE DC F'5'
FOUR DC F'4'
TEMP DS 1F
END PG1

3. USING THE ABOVE DESIGN GIVE THE OUTPUT OF pass1 and pass2 FOR THE FOLLOWING CODE
Pg2 start 0

Using *, B
L 1, Two
AR 1, Three
A 1,Three
M 1, =F'2'
ST 1, Temp
SR 2,2
B EQU 4
Two DC H'2'
Three DC f'2'
Temp DS 1F
END

4. Give analysis and design of single pass assembler for the input given on question 2
(Students are expected to write contents of ST, LT and FRT)

Assignment: 2

Sub: SPCC

Topic: Phases of co,piler

Date: Last week of April

co4: Design various parsing techniques

1. Design LR(1) parser for the grammar given below

$A \rightarrow (A)$

$A \rightarrow a$

Check whether input **(a)** is valid

2. Design predictive parser for the grammar given below

$E \rightarrow T E'$

$E' \rightarrow +TE' \mid \text{NULL}$

$T \rightarrow (E) \mid \text{id}$

Check whether input **id*id+** is valid

Consider the grammar given below:

$S \rightarrow Aa$

$A \rightarrow BD$

$B \rightarrow b \mid \epsilon$

$D \rightarrow d \mid \epsilon$

Let a, b, d, and \$ be indexed as follows:

a	b	d	\$
3	2	1	0

Compute the FOLLOW set of the non-terminal B and write the index values for the symbols in the FOLLOW set in the descending order. (For example, if the FOLLOW set is {a, b, d, \$}, then the answer should be 3210)

Gate-2019

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T.E. (Computer) (semester VI)
(2020-2021)

Lesson Plan: SPCC

Semester VI

Year: 2020-21

Modes of Content Delivery:

I	Class Room Teaching	V	Self Learning Online Resources	Ix	Industry Visit
Ii	Tutorial	vi	Slides	X	Group Discussion
Iii	Remedial Coaching	vii	Simulations/Demonstrations	xi	Seminar
Iv	Lab Experiment	viii	Expert Lecture	xii	Case Study

Lect. No.	Portion to be covered	Planned date	Actual date	Content Delivery Method/Learning Activities
1	Concept of System Software, Goals of system softwares, system program and system programming,	27-01-21		Online Teaching, Lab experiment , Self Learning Online Resources
2	Introduction to various system programs such as Assembler, Macro processor, Loader, Linker, Compiler, Interpreter, Device Drivers, Operating system, Editors, Debuggers.	28-01-21		Online Teaching, Lab experiment , Self Learning Online Resources
3	Elements of Assembly Language programming	29-01-21		Online Teaching, Lab experiment , Self Learning Online Resources
4	Pass structure of assembler	02-02-21		Class Room Teaching, Lab experiment , Self Learning Online Resources
5	Assembler Design: Two pass assembler Design and single pass Assembler Design for Hypothetical / X86 family processor, data structures used.	03-02-21		Online Teaching, Lab experiment , Self Learning Online Resources
6	Assembler Design: Two pass assembler Design and single pass Assembler Design for Hypothetical / X86 family processor, data structures used	04-02-21		Online Teaching, Lab experiment , Self Learning Online Resources
7	single pass Assembler Design for Hypothetica	05-02-21		Online Teaching, Lab experiment , Self Learning Online Resources

8	single pass Assembler Design for Hypothetical processor, data structures used.	09-02-21		Online Teaching, Lab experiment , Self Learning Online Resources
9	Features of Macro facility: Simple, parameterized, conditional and nested	10-02-21		Online Teaching, Lab experiment , Self Learning Online Resources
10	Design of two pass macro processor, data structures used.	11-02-21		Online Teaching, Lab experiment , Self Learning Online Resources
11	Design of two pass macro processor, data structures used.	12-02-21		Online Teaching, Lab experiment , Self Learning Online Resources
12	Design of single pass macro processor, data structures used.	16-02-21		Online Teaching, Lab experiment , Self Learning Online Resources
13	Introduction, functions of loaders, Relocation and Linking concept	17-02-21		Online Teaching, Lab experiment , Self Learning Online Resources
14	Direct Linking Loader,	18-02-21		Online Teaching, Lab experiment , Self Learning Online Resources
15	Direct Linking Loader,	02-03-21		Online Teaching, Lab experiment , Self Learning Online Resources
16	Dynamic linking and loading.	03-03-21		Online Teaching, Lab experiment , Self Learning Online Resources
17	Introduction to compilers, Phases of compilers	04-03-21		Online Teaching, Lab experiment , Self Learning Online Resources
18	Lexical Analysis- Role of Finite State Automata in Lexical Analysis	05-03-21		Online Teaching, Lab experiment , Self Learning Online Resources
21	Study of Lex tool	22-03-21		Online Teaching, Case Study, Lab Experiment Simulations/Demonstrations
22	Types of Parsers: Top down parser	23-03-21		Online Teaching, Case Study, Lab Experiment
23	Design of Predictive parser	24-03-21		Online Teaching, Case Study, Lab Experiment
24	Design of Predictive parser and LL(1) Grammar	25-03-21		Online Teaching, Lab Experiment
25	Design of recursive descent parser	30-03-21		Online Teaching
26	Bottom up parser- Operator precedence parser	31-03-21		Online Teaching

27	Design of SLR Parser	01-04-21		Online Teaching
28	Design of LR1 parser	15-04-21		Online Teaching, , Lab Experiment
29	More Examples on parsers	16-04-21		Online Teaching
30	More Examples on parsers	27-04-21		Online Teaching
31	Semantic Analysis	28-04-21		Online Teaching
32	Syntax directed definitions.	29-04-21		Online Teaching
33	Intermediate Code Generation: Types of Intermediate codes: Syntax tree, Postfix notation, Three address codes: Triples and Quadruples.	30-04-21		Online Teaching, Self Learning Online Resources
34	Intermediate Code Generation: examples	11-05-21		Online Teaching, Self Learning Online Resources
35	Code Optimization: Need and sources of optimization	11-05-21		Online Teaching, Self Learning Online Resources
36	Code optimization techniques: Machine Dependent	12-05-21		Online Teaching, Self Learning Online Resources , slides
37	Code optimization techniques: Machine InDependent	12-05-21		Online Teaching, Self Learning Online Resources
38	Code optimization techniques: Machine Dependent	13-05-21		Online Teaching, Self Learning Online Resources
39	Code Generation: Issues in the design of code generator,	18-05-21		Online Teaching, Self Learning Online Resources
40	code generation algorithm.	18-05-21		Online Teaching, Self Learning Online Resources
41	Basic block and flow graph.	19-05-21		Online Teaching, Lab experiment , Self Learning Online Resources
42	University Paper Discussion	19-05-21		Online Teaching, , Self Learning Online Resources
43	University Paper Discussion			Online Teaching

Online Study Material

1. <https://nptel.ac.in/courses/106/108/106108113/>
2. <https://nptel.ac.in/courses/106/105/106105190/>
3. https://www.tutorialspoint.com/compiler_design/index.htm
4. <https://www.geeksforgeeks.org/last-minute-notes-compiler-design-gg/>
5. <https://pvq.ravindrababuravula.com/subject/?cs=Compiler-Design>
6. <https://www.youtube.com/watch?v=oAnkQJT85Ts>