

BITS, Pilani – Dubai Campus, Knowledge Village, Dubai.  
III Year SECOND Semester 2003-2004

Degree: B.E.(Hons.). Branch: C.S.E.

**Comprehensive Examination Question Paper**

Course No : CSUC 362 Course Title: Programming Languages and  
Compiler Construction

Date: 08/06/2004 Tuesday Time: 10 a.m. - 1 Noon Total marks: 60

Data provided are complete. *Closed Book.*

**Part A**

Answer all Questions.

5 \* 2 = 10 Marks

1. What is the function of REGISTER ALLOCATION and ASSIGNMENT w.r.t. Compiler Design?
2. What is Common Subexpression Elimination? Give an example.
3. What is the purpose of INSTRUCTION SELECTION phase of a Compiler?
4. What is Flow-of-Control checks in Type Checking? Give an example
5. Write regular expressions for the following character sets (languages), or give reason why no regular expression can be written:
  - a. All strings of digits that contain **no leading zeroes**.
  - b. All strings of digits that represent **even numbers**.

**Part B.**

Answer all Questions

6. Write LEX SOURCE [program] to recognize, validate and change a DATE in American format to that in BRITISH format.

(i.e mm/dd/yyyy → dd/mm/yy)

Examples: **Input prompt:** Enter Date ( mm/dd/yyyy) : 10 / 12 / 2000

OUTPUT: 12 / 10 / 2000

: **Input prompt:** Enter Date ( mm/dd/yyyy) : 37 / 23 / 2000

OUTPUT: ERROR

(Note: Assume *correct input* for FEB; For *other mm* or *dd*, there could be correct as well as wrong inputs) [8 marks]

7. a) In PREDICTIVE PARSING, define the following TERMS:

FIRST(X)

FOLLOW(X)

NULLABLE

[3 marks]

b) Consider the following CFG:

$Z \rightarrow d$

$Y \rightarrow \epsilon$

$X \rightarrow Y$

$Z \rightarrow XYZ$

$Y \rightarrow c$

$X \rightarrow a$

	NULLABLE	FIRST	FOLLOW
X	YES	a, c	a, c, d
Y	YES	c	a, c, d
Z	NO	a, c, d	

Draw the PREDICTIVE PARSING TABLE for the above CFG.

[4 marks]

Part C. Answer any FIVE Questions. 5 \* 7 = 35 Marks.

8. Eliminate all left recursions and common prefixes, if any, from the following grammars:

a)  $N \rightarrow Nr \mid M$

[2M]

b)  $N \rightarrow rM \mid rS$

[2M]

c) Write down the ASSOCIATIVITY and PRECEDENCE of the following three OPERATORS in C:

<=

++

\*=

[3 marks]

9. Explain CALL by VALUE and CALL by REFERENCE with an example in any higher level language like C/C++.

[3.5 + 3.5 Marks]

10. Draw the layout of a typical STACK FRAME (ACTIVATION RECORD) for a function and briefly explain its contents.

[7 marks]

11. Break the following program into BASIC BLOCKS and Write them.

$1. m \leftarrow 0$   
 $2. v \leftarrow 0$   
 $3. \text{if } v \geq n \text{ goto } 15$   
 $4. r \leftarrow v$   
 $5. s \leftarrow 0$   
 $6. \text{if } r < n \text{ goto } 9$   
 $7. v \leftarrow v + 1$   
 $8. \text{goto } 3$   
 $9. x \leftarrow M[r]$   
 $10. s \leftarrow s + x$   
 $11. \text{if } s \leq m \text{ goto } 13$   
 $12. m \leftarrow s$   
 $13. r \leftarrow r + 1$   
 $14. \text{goto } 6$   
 $15. \text{return } m$

[7 marks]

12. Write the YACC source (specification) for a **small desk calculator** that performs addition, subtraction, multiplication and division on input NUMBERS. Assume that the NUMBERS are  
positive INTEGERS  
or  
positive REAL NUMBERS with 2 digits after decimal point.

Example:

INPUT	OUTPUT
14.26+26.14	40.40
(14.26+26.14)	40.40
(14+14.20)	28.20
(14+14)	28.00

[7 Marks]

13. a) Explain the following kinds of EXPRESSIONS w.r.t intermediate representation tree (.IR TREE)::

- TEMP(t)
- MEM(e)
- CALL(f, l)
- NAME(n)

[4 Marks]

b) What is SINGLE INHERITANCE in an Object-Oriented Language? [1M]

c) Define LIVENESS Analysis. [1M]

d) Fill in the blanks: HEAP-ALLOCATED records that are not reachable by any chain of pointers from program variables are \_\_\_\_\_.

[1 M]

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Answer all Questions

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Draw the PREDICTIVE PARSING TABLE for the above CFG.

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a)  $N \rightarrow Nr \mid M$

[2M]

b)  $N \rightarrow rM \mid rs$

[2M]

c) Write down the ASSOCIATIVITY and PRECEDENCE of the following three OPERATORS in C:

$\leq$

$++$

$*=$

[3 marks]

9. Explain CALL by VALUE and CALL by REFERENCE with an example in any higher level language like C/C++.

[3.5 + 3.5 Marks]

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4.  $r \leftarrow v$
5.  $s \leftarrow 0$
6. if  $r < n$  goto 9
7.  $v \leftarrow v + 1$
8. goto 3
9.  $x \leftarrow M[r]$
10.  $s \leftarrow s + x$
11. if  $s \leq m$  goto 13
12.  $m \leftarrow s$
13.  $r \leftarrow r + 1$
14. goto 6
15. return m

[7 marks]

12. Write the YACC source (specification) for a **small desk calculator** that performs addition, subtraction, multiplication and division on input NUMBERS. Assume that the NUMBERS are  
positive INTEGERS  
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[7 Marks]

13. a) Explain the following kinds of EXPRESSIONS w.r.t intermediate representation tree (.IR TREE)::
- TEMP(t)
  - MEM(e)
  - CALL(f, l)
  - NAME(n)
- [4 Marks]
- b) What is SINGLE INHERITANCE in an Object-Oriented Language? [1M]
- c) Define LIVENESS Analysis. [1M]
- d) Fill in the blanks: HEAP-ALLOCATED records that are not reachable by any chain of pointers from program variables are -----.
- [1 M]

QUIZ

Course No : CSUC362 Course Title: Programming Languages and Compiler Construction  
Date: 19, May, 2004 Wednesday Time: 12 noon - 12.30 noon Total marks: 10  
Weightage: 10% Venue : EG LAB. *Closed Book*.

IDNO:

Name:

Write answers in the space provided in question paper. Answer all questions.

Note: \_\_\_\_\_ means one or more words to be filled within a line.

- 1, 2. In a Canonical Tree, the parent of each CALL is either \_\_\_\_\_  
or \_\_\_\_\_.
3. In Single Inheritance, each Class extends just one \_\_\_\_\_.
4. The \_\_\_\_\_ of compiler does Optimization of Intermediate Representation and Translation to Machine Language.
- 5, 6, 7. In the Basic Block, the first statement is a \_\_\_\_\_  
and the last statement is a \_\_\_\_\_ or \_\_\_\_\_.
8. In \_\_\_\_\_, one subclass can have several parent classes.
- 9, 10. In the IR Tree, consider the expression  $\text{BINOP}(o, e_1, e_2)$ .  
Here,  $o$  stands for \_\_\_\_\_ and  
 $e_1$  &  $e_2$  stand for \_\_\_\_\_.
11. A \_\_\_\_\_ field is one that cannot be fetched or updated from any function or method declared outside the object.
12. A \_\_\_\_\_ is a sequence of statements that could be consecutively executed during the execution of the program.
13. Information Hiding is also referred to as Encapsulation. Is this statement TRUE or FALSE ?  
\_\_\_\_\_

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IDNO:

Name:

14, 15, 16. The front end of the compiler does -----,  
-----, Semantic Analysis and  
-----.

17. In IR Tree, the statement EXP(e) means  
-----.

18. In IR Tree,  $SEQ(s_1, s_2)$  means  
-----.

19. BINOP(op, ESEQ(s, e1), e2) can be rewritten as  
-----.

using identities on trees.

[1 Mark]



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TEST II Question Paper

Course No : CSUC362 Course Title: Programming Languages and  
Compiler Construction

Date: 16, MAY, 2004 Sunday Time: 9.30 a.m. - 10.20 a.m. Total marks: 20

Data provided are complete. **OPEN BOOK**

Answer all Questions.

I

a) Write YACC specification [source] for the following CFG:

$S \rightarrow ABbC$

$A \rightarrow a \mid CB \mid \epsilon$

$B \rightarrow C \mid dAa \mid \epsilon$

$C \rightarrow e \mid f \mid \epsilon$

(4M)

b) Which of the following **input strings**, satisfy the above grammar?

1) be 2) adaabe 3) daabe 4) fbe (2M)

II. What information does an Abstract Syntax Tree Convey? (2M)

III. Consider the following portion of a C program:

```
#include <stdio.h>
main() {
    int a; float b; char c[10], *d;
    a=(a + 5) * (d);
    b=b++ * (c);
    c=a+c-d;
    c[5] = 'a'; }
```

Write down, INVALID OPERATIONS, if any in the above portion of C code.  
[2M]

IV. Explain OVERLOADING of '+' operator with an example in any higher level  
language [ C / C++ ]. [2M]

V. Suppose a function pq(..) is called by function mn(...). Write down the names of the  
CALLER and CALLEE. [1M]

course  
file

VI. How does YACC handle REDUCE / REDUCE CONFLICT and SHIFT / REDUCE CONFLICT?  
[2M]

VII. Where are the local variables, parameters, return address and other temporaries for a function stored?  
[1M]

VIII. It is required to insert the following eight strings in a Symbol Table:

ANT BAT RAT TINY NEAR IT BEAM TRAIN

Assume a HASH TABLE implementation for the Symbol Table and the hash function is defined as follows:

"Add the ASCII values of individual letters in a *given input string* [ASCII value of 'A' is 65 and so on] and find the sum.  
Hash Value =  $\text{sum} \% 10$  [i.e. sum modulus 10]". This hash value will be the position at which the input string will be inserted.

Now Insert all the above eight input strings at appropriate positions in the Hash Table.  
[4M]

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Individual Assignment

Course No : CS UC362 Course Title: Prg. Langs. & Compiler Const.  
Due Date: 24/03/2004 Total marks: 20 Weightage: 10% Issued on: 01/03/2004

Evaluation: Demonstration: 9 + 4 VIVA: 4 Record: 3

Note: A Student should work individually and submit the assignment in a file folder.

Delayed Submission will result in reduction in marks obtained.

Record should contain LEX / YACC Source, Test Input Data, Output Results.

1. Using LEX and YACC, Check whether an ASSIGNMENT STATEMENT written in C [given as input from standard input or File ] is SYNTACTICALLY CORRECT. Consider the following ASSIGNMENT OPERATORS ONLY:  
= += -= \*= /=  
[9]

2. Write a LEX Source to Recognize a COMPLEX NUMBER and separate out the REAL and IMAGINARY parts. Assume that the Real Part and Imaginary Part involves integers / integer variables.

Example:

INPUT	OUTPUT
42+31i	RP=42 IP=31
AA-i2	RP=AA IP=-2
AB+iCD	RP=AB IP=CD
AB - CDi	RP=AB IP=-CD
31i-42	RP=-42 IP=31

[4]

VIVA : 4 RECORD: 3

B. Vijayakumar

BITS, Pilani – Dubai Campus, Knowledge Village, Dubai.

III Year Second Semester 2003-2004

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Individual Assignment / *Scheme*

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= += -= \*= /= [9]
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Example:

INPUT	OUTPUT
42+31i	RP=42 IP=31
AA-i2	RP=AA IP=-2
AB+iCD	RP=AB IP=CD
AB - CDi	RP=AB IP=-CD
31i-42	RP=-42 IP=31 [4]

VIVA : 4 RECORD: 3

The demonstrations are to be conducted in Lab (computer).

B-Vijayakumar