

BITS, Pilani – Dubai Campus, Knowledge Village, Dubai.
III Year SECOND Semester 2006-2007

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

Comprehensive Examination Question Paper

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

Date: 27/05/07 Sunday Time: 10 a.m. - 1 Noon Total marks: 60

Data provided are complete. *Closed Book*.

This question paper has 5 pages.

Part A

Answer **all** Questions.

10 * 2 = 20 Marks

1. What is DELAYED LINKING ? How is it implemented in UNIX ?
2. Define and give an example for each of the following errors: LOGICAL ERROR, LEXICAL ERROR.
3. In SEMANTIC ANALYSIS, Give 2 examples for analysis of context-sensitive information.
4. How are the variables accessed in STACK FRAME / ACTIVATION RECORD in each of the following situations:
 - a) Variables in current scope
 - b) Variables in an outer scope.
5. Show the right hand side for the following rewriting rule w.r.t canonical tree:
BINOP(op, ESEQ(s, e1), e2) = -----
6. Write down the steps involved in building BASIC BLOCKS.
7. Write a recursive **mark** method w.r.t. garbage collection, for an object **p** and all the objects indirectly accessible from **p**.
8. What is an Interference Graph in Register Allocation ?
9. Distinguish between LIVE-IN and LIVE-OUT in LIVENESS ANALYSIS.
10. Identify the TOKENS and LEXEMES in the following C Program Segment:

```
main()
{
    int a;      for (a = 1; a <= 10; a++)
                printf( "%d\n", a);
}
```

Part B. Answer all Questions

11. Find the NULLABLE, FIRST and FOLLOW sets for the following CFG and then Construct the PREDICTIVE PARSING TABLE: (2+2.5+2.5+3 marks)

(Note: here ϵ denotes null)

Program \rightarrow **begin** *OptStmts* **end**
OptStmts \rightarrow *Stmt* *MoreStmts*
MoreStmts \rightarrow ; *Stmt* *MoreStmts*
OptStmts \rightarrow ϵ
Stmt \rightarrow **if** *Exp* **then** *Stmt*
MoreStmts \rightarrow ϵ
Stmt \rightarrow **id** = *Exp*
Exp \rightarrow **id**
Exp \rightarrow **int**

12. Write a JAVA program for the following problem: (4 marks)

“Read as input an English language word. (the length of the word should not exceed 30 characters. Assume that input is given only in lower case alphabets. You can read from KEYBOARD or FILE or initialize using a Constructor)

Your program should count the number of occurrences of each letter in the input and display them.”

Sample Session:

INPUT	OUTPUT	
denudation	alphabet	count
	a	1
	d	2
	e	1
	i	1
	n	2
	o	1
	t	1
	u	1

13. Consider a *simple assignment statement*:

$$d := (a+10) + (a - 5) + (c + d)$$

You are required to generate CODE for the above statement using a simple code generation algorithm and tabulate your steps as shown below:

Statements	Code Generated	Register Descriptor	Address Descriptor
.....

[5 marks]

14. You are required to write **LEX SOURCE** and **YACC SOURCE** for the following problem:

Using LEX and YACC, Check whether a given "while" statement (read from a text file using < i.e. input redirection) entered by the user , is *syntactically correct* according to C Language Syntax. You can make the following assumptions:

- i) The assignment operators to be considered are: = += -= *= /=
- ii) Arithmetic operators to be considered are: + - * /
- iii) An expression can have () **identifiers numbers**(only positive integers).
- iv) The relational operators considered are: < <= > >=
- v) Assume that there can be only one loop variable.
- vi) Only assignment expression / statement is considered for simplicity.
- vii) Curly braces (left as well as right) indicate beginning and end of block.

Some valid Inputs are shown here:

```
while ( i <= 20 ) { sum = sum + i; i += 1; }
while ( i <= 20 ) { sum += sum + i; i -= 2; }
while ( i <= a ) { sum *= i; i /= 2; }
while ( i ) { sum += i; i = i + 1; }
```

For each of the above inputs, you can **echo the statement** and display the following message on screen:

"YOUR STATEMENT is SYNTACTICALLY CORRECT".

Also, check for inputs with some mistakes [like junk values, missing:-bracket, variable, operator etc]. In this case, you can echo the statement and display the following message on screen:

"YOUR STATEMENT SYNTAX IS WRONG". [4+6 marks]

15. Explain the action of the following PICO LISP code: (2 marks)

```
(in "a"
  (out "b"
    (echo 40) ) )
```

16. Write the output generated by the following C program: (4 marks)

```
#include <stdio.h>
void fn (int);
void fn1 (int *);
static int val = 3;
int s;
main ()
{
    while (val--)
        fn (val);
    printf (".... %d\n", val);
    s = val;
    fn1 (&s);
}
void
fn (int val)
{
    int val2 = 0;
    val2 = val;
    for (; val2 < 6; val2++)
        printf ("%d \n", val2);
}
void
fn1 (int *s)
{
    printf ("%d\n", (*s) + 1);
    printf ("%d\n", ++(*s) + 2);
    printf ("%d\n", (*s)++ + 3);
    printf ("%d\n", (*s) + 4);
}
```

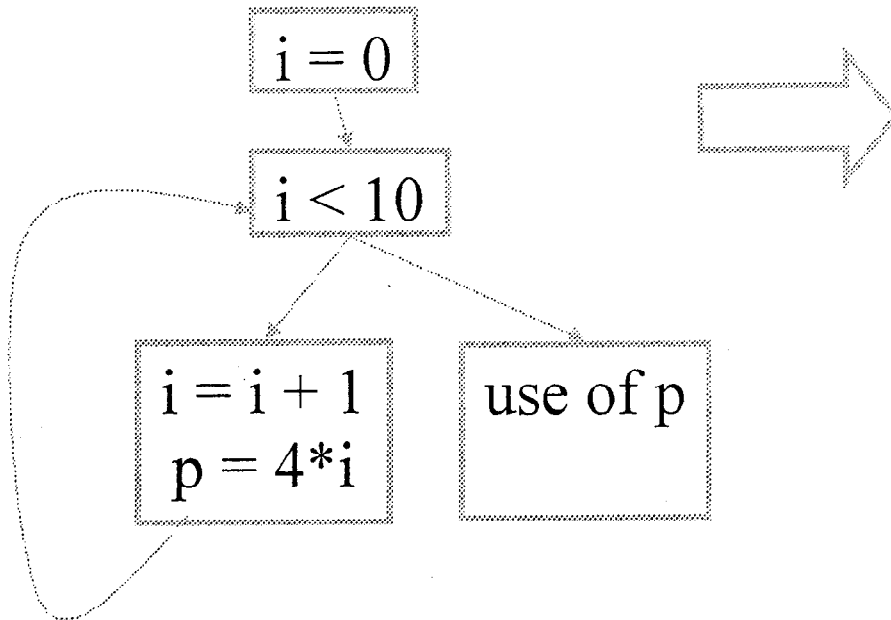
17. Write the Prolog definition (code) of Ackermann's function : (3 marks)
Ackermann's function has two parameters whose value grows very fast.

$A(m, n) =$

- $n+1$, for $m = 0$ & $n \geq 0$
- $A(m-1, 1)$, for $n = 0$ & $m > 0$
- $A(m-1, A(m, n-1))$, for $m, n > 0$.

$m = 0$	$A(0, n) = n+1$
$m > 0, n = 0$	$A(m, 0) = A(m-1, 1)$
$m > 0, n > 0$	$A(m, n) = A(m-1, A(m, n-1))$

18. Perform Code Optimization, if any, in the following segment, shown in the following Program Flow Graph: (2 marks)



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TEST II Question Paper

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

Date: 15 April, 2007 Sunday Time: 50 minutes Total marks: 20

Data provided are complete. **OPEN Book.**

This question paper has two pages.

Answer all Questions.

1. Write the OUTPUT of the following JAVA Program: [5 marks]

```
public class T20607 {
    public static void main(String[] args) {
        for(int i = 60; i < 80; i++) {
            switch(i % 35) {
                case 0:
                    System.out.print("MY OUTPUT ");
                    break;
                case 5: case 10: case 15:
                case 20: case 25: case 30:
                    System.out.print("UF ");
                    break;
                case 7: case 14: case 21: case 28:
                    System.out.print("BV ");
                    break;
                default:
                    System.out.print(( i*i + 1 ) + " ");
                    break;
            }
        }
        System.out.println();
    }
}
```

2. Why do you *eliminate Left Recursion* and *do Left Factoring* in a Predictive Parser ?
[1 mark]

3. What is ATTRIBUTE INFORMATION w.r.t. SYMBOL TABLE ? [1 mark]

4. Why do need UNIQUENESS CHECK in TYPE CHECKING ? Give an example for uniqueness check. [1 mark]

P.T.O.

5. Write a JAVA program to check whether a given **two dimensional array** of **size 3 by 3** [you can initialize its elements using any technique of your choice in your program] can form a **magic square** or **not**. {Your Answer should be YES or NO}. You can use the following TEST DATA alone in your program

6	11	10
13	9	5
8	7	12

[4 marks]

Note: In a Magic Square, The **SUM of Numbers ACROSS ROWS, COLUMNS and DIAGONALS is same** and the number in each cell is unique. Your Program should only check for presence of magic square or not. You **need not** get into **logic** for magic square construction.

6. Find the NULLABLE, FIRST and FOLLOW sets for the following CFG and then Construct the PREDICTIVE PARSING TABLE:

(1+2+2+3 marks)

$S \rightarrow ABc$

$A \rightarrow aA \mid \epsilon$

$B \rightarrow bB \mid \epsilon$

(Note: here ϵ denotes null and S is the Start Symbol, Non-Terminals are *Italicized* and Terminals are in **bold**.)

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TEST I Question Paper

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

Date: 4 Mar., 2007 Sunday Time: 50 minutes Total marks: 20

Data provided are complete. **Closed Book.**

Answer all Questions.

1. Write the OUTPUT of the following C Program: [5 marks]

```
#include <stdio.h>
main ()
{
    void e (int xx, int *nn);
    int x[10], i;
    int n = 4;
    for (i = 0; i < 10; i += 1)
    {
        x[i] = 2 * n;
        e (x[i], &n);
        n = n * 2 + 1;
    }
}
void
e (int xx, int *nn)
{
    int m, z;
    m = *nn * 2;
    z = xx + 4;

    printf (" m = %d z= %d \n", m, z);
}
```

2. Write a LEX program [source] to recognize & print out all HTML tags from input (read from file or keyboard) and ignore invalid data.

Note: HTML tags enclose data between < >. [3 marks]

INPUT	OUTPUT
<hff>	<hff>
44h4b	
<14267sbhsj>	<14267sbhsj>
Fsahdha	

P.T.O.

3. Write down the **Binding Times** for each of the following **Properties**: [2 marks]

PROPERTY	BINDING TIME
Values of Variables	
Object Code for External Function Name	
Types of Variables	
Memory Locations for Code for Functions	

4. Write the **REGULAR EXPRESSION** in **LEX** format for each of the following descriptions: [2 marks]

DESCRIPTION	Regular Expression in LEX format
An x at the beginning of a line	
An x but only if followed by y	
m through n occurrences of x	
Any character but x	

5. What are the functions of **Semantic Analyzer & Symbol Table** in a compiler ? [2 marks]

6. What are the basic features of a **Block Structured Programming Language**? [2 marks]

7. a) Consider the following facts in **SWI-PROLOG**.

```
male(Person).
female(Person).
parent(Parent,Child).
```

father and **mother** could be rules. **Complete** the following rules given below:

```
father(Parent,Child) :-
mother(Parent,Child) :-
```

[2 marks]

b) What is the meaning of the following logical operators in **SWI-PROLOG**: [2 marks]

SYMBOL	OPERATION
,	
;	
:-	
->	