

Comprehensive Examination **Question Paper**
BITS, Pilani – Dubai. International Academic City
III Year SECOND Semester 2009-2010

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

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

Date: 25/05/10 Tuesday Time: 10 a.m.- 1 Noon Total marks: 80 Weight-age: 40%

Data provided are complete. *Closed Book.*

This question paper has 5 pages.

PART A: (*write in PART A answer booklet*)

Answer **all** Questions

A.1.) What are the advantages of DELAYED LINKING w.r.t. Language Systems? [2M]

A.2.) What are the functions of a Lexical Analyzer? [2 M]

A.3.) What is the purpose of **def** and **use** in *liveness analysis*? [2 M]

A.4.) Define FIRST(α) and FOLLOW(A) in top down parsing. [2 M]

(note: here α is any string of grammar symbols; A is a non-terminal.)

A.5) Distinguish between CALL by REFERENCE and CALL by VALUE in parameter passing. [2 M]

A.6.) Write a PICO LISP program to implement the following RECURRENCE
RELATION: (Assume that n is ≥ 0).

$T(n) =$

- $n^2 + 4n + 3$, for $n=0,1$.
- $2T(n-1) + 3T(n-2)$ for $n > 1$. [5 M]

A.7.) SWI PROLOG program & Queries for a simple database application [7 M]

a) Store the following information in a SWI PROLOG Database.

AUTHOR		BOOK	
AID	ANAME	BID	BNAME
-----	-----	-----	-----
a1	aho	b1	multimedia
a2	sethi	b2	dragon_book
a3	ullman	b3	java_compiler
a4	appel	b4	database
a5	bvk	b5	swe

P.T.O.

BOOK_	AUTHOR
BID	AID
-----	-----
b1	a5
b2	a1
b2	a2
b2	a3
b3	a4
b4	a3
b5	a2
b5	a5

b) Answer these queries in SWI PROLOG:

- List all books of a given AID (author id). i.e. you must display the *author name* and *book name(s)* for a given AID.
- List all authors of a given BID (book id). i.e. you must display the *book name* and *author name(s)* for a given BID.

example: When you give AID as *a5*, you must display this output:

bvk multimedia
bvk swe

A.8.) SHIFT-REDUCE PARSING ACTIONS in a tabular form

[8 M]

Consider the following CFG:

$E \rightarrow E + E$

$E \rightarrow E * E$

$E \rightarrow (E)$

$E \rightarrow \text{id}$

You are given the following input string: **(id1 * id2) + (id3 + id4)**

Now, **Tabulate** the SR parsing actions for the above input string as shown below:

STACK	INPUT	ACTION
.....
.....

P.T.O.

A.9.) Write a JAVA program involving *Class Inheritance* for a simple *book information system* as specified below:

[10 M]

- Create a base class **Info** that can store the following attributes [i.e. data items] **name** (of type string) , **author** (of type string) and **year** (of type integer). This class can contain a *constructor* to set the values for the attributes **name**, **author** and **year**. This class contains another *method* to display the **name**, **author** and **year**.

- Create a derived class **Book** that extends the base class. This class can store an attribute **categorycode** of type integer. (Assume that the *categorycode* can have a value **1** or **2** or **3** when an object is created). This class can contain a constructor to set the values for **name**, **author**, **year** and **categorycode**. This class contains another *method* to display the **name**, **author**, **year**, **categorycode**. It also prints **one** of the following *messages* according to the value of **categorycode**:

If *categorycode*=1, it displays the message, "Philosophy".

If *categorycode*=2, it displays the message, "Novel-Fiction".

If *categorycode*=3, it displays the message, "Autobiography".

-Create a Class **Inheritance_Testing**. This class can store the **main** function. Now you create the following three objects for the class **Book**:

"The Firm" "John Grisham 1991 2

"My Experiments with Truth" "M. K. Gandhi" 1925 3

"By Parallel Reasoning" "Paul Bartha 2010 1

Now print all these objects along with their appropriate messages.

P.T.O.

PART B (write in *PART B answer booklet*)
Answer **all** Questions

B.1.) Distinguish between SYNTHESISED ATTRIBUTE and INHERITED ATTRIBUTE in syntax directed definition. [2 M]

B.2.) Explain Common *Sub-expression Elimination* in CODE OPTIMIZATION with an example. [2 M]

B.3.) Define FLOW OF CONTROL CHECKS and UNIQUENESS CHECKS in TYPE CHECKING. Mention an example in each category. [2 M]

B.4.) Briefly outline the action of REFERENCE COUNTING in garbage collection (GC) strategy. [2 M]

B. 5). Give a *brief outline* (steps) of an *Overall Algorithm* w.r.t. Register Allocation. [5 M]

B.6.) Consider a *simple assignment statement*:

$$d := (a-20) + (a + 2) - (c + d)$$

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

Statement(s)	Code Generated	Register Descriptor	Address Descriptor
.....
.....

[5 M]

B.7.) Break the following program into BASIC BLOCKS and Write them.

1. $i \leftarrow 1$
2. $j \leftarrow 1$
3. $t1 \leftarrow 10 * i$
4. $t2 \leftarrow t1 + j$
5. $t3 \leftarrow 8 * t2$
6. $t4 \leftarrow t3 - 88$
7. $a[t4] \leftarrow 0.0$
8. $j \leftarrow j + 1$
9. if $j \leq 10$ goto 3
10. $i \leftarrow i + 1$
11. if $i \leq 10$ goto 2
12. $i \leftarrow 1$
13. $t5 \leftarrow i - 1$
14. $t6 \leftarrow 88 * t5$
15. $a[t6] \leftarrow 1.0$
16. $i \leftarrow i + 1$
17. if $i \leq 10$ goto 13

[6 M]

B.8). Draw the layout of a typical STACK FRAME (ACTIVATION RECORD) for a function and briefly explain its contents. [6 M]

B.9.) Using **LEX** and **YACC**, Check whether a given “SQL” command (read from input text file) entered by an user, is syntactically correct according to SQL Syntax. [i.e. you have to **write LEX source program** and **YACC source program**]. [5+5 M]

Consider **only one** POSTGRES SQL command whose *syntax* and *Test Scenario* are given below:

TRIGGER

Syntax: **create trigger** *name*

before *event*

on *table*

for each row

execute procedure *func(arguments)*

Test Scenario

Input Data:

```
create trigger pres before insert on student for each row execute
procedure myfunct ( idno )
```

wertyu

Output Result:

```
create trigger pres before insert on student for each row execute
procedure myfunct ( idno )
```

Syntax Correct

wertyu

Syntax is wrong

TEST II Question Paper

BITS, Pilani – Dubai, Dubai International Academic City

III Year SECOND SEMESTER 2009-2010

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

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

Date: 02nd May, 2010 Sunday Time: 50 minutes Total marks: 40 (20% wt.)

Data provided are complete. **OPEN Book**. This qn paper has **2 pages**.

Textbook, Reference Book and student's own handwritten class notes permitted.

Answer all Questions.

1. It is required to store various strings in a **Symbol Table**. Assume a HASH TABLE implementation for the Symbol Table and the hash function is defined as follows:

Read in a string and calculate its **hash value** using the hash function given below. You can permit collisions, in case if they occur [i.e. one or more strings can map to the same hash value; you can store them in the same sub-list corresponding to the computed hash value] Assume that the input string has *English alphabets* (upper case and lower case) and *digits*. Note the range of ASCII values for A-Z is **65-90**, a-z is **97-122** and digits 0-9 is **48-57**.

HASH FUNCTION for an input string is defined as follows:

HASH VALUE=

$(\text{sum of ASCII values of the English alphabets} - \text{sum of ASCII values of digits present in the string}) * 10 + 4) \text{ MOD } 10$

Example : Input String : **Az9**

Hash Value = $((65+122-57) * 10 + 4) \text{ mod } 10 = 4$

Note: MOD denotes modulus operator [i.e. remainder after division]

Compute the hash values for each of the following input strings:

a) **A2y** b) **D3x** c) **C4w** d) **E5v** e) **F2u** f) **B2t**

Draw the layout of the Symbol Table showing its contents. [6+2 M]

2. Construct the DAG (directed acyclic graph for higher level representation of intermediate code) for the following arithmetic expression:

$a / (a + b) + c / (a + b) + d / (g + h) + j / (g + h)$ [4 M]

3. **Translate** the following expression into *intermediate code* using STACK MANIPULATION (**lvalue**, **rvalue**, **push**, **pop**, **:=** etc) operations in an ABSTRACT STACK MACHINE :

$a := (c + d) + (m * n) + (p * q) + l$

[4 M]

4. Why do you need SEMANTIC ANALYSIS and TYPE CHECKING actions in compiler design ? [2 M]

P.T.O.

5. Translate the following program segment into Three Address Code (Quadruples):

```

begin
  while ( i < 12)
    begin
      k = k + 4
      j = k + 2
      i = i + 1
    end
  j = j + 2
end

```

Assume that i, j, k are all integers whose initial values are zero. [4 marks]

6. Consider the following syntax directed definition for a desk calculator program:

PRODUCTION	SEMANTIC RULES
$L \rightarrow E \mathbf{n}$	$\text{print}(E.\text{val})$
$E \rightarrow E_1 + T$	$E.\text{val} = E_1.\text{val} + T.\text{val}$
$E \rightarrow T$	$E.\text{val} = T.\text{val}$
$T \rightarrow T_1 * F$	$T.\text{val} = T_1.\text{val} * F.\text{val}$
$T \rightarrow F$	$T.\text{val} = F.\text{val}$
$F \rightarrow (E)$	$F.\text{val} = E.\text{val}$
$F \rightarrow \text{digit}$	$F.\text{val} = \text{digit.lexval}$

Here \mathbf{n} denotes newline.

Construct an *annotated* PARSE TREE for the following input expression:

$(6 * 2 + 5 * 3 + 4 * 4) \mathbf{n}$

[6 M]

7. Find the NULLABLE, FIRST and FOLLOW sets for the following CFG and then

Construct the PREDICTIVE PARSING TABLE: (3+3+1+5 M)

```

query      → coll
coll       → sfw
sfw        → SELECT opt_distinct proj_list FROM from_item_list opt_where
opt_distinct → DISTINCT | ε
proj_list  → * | proj_item_list
proj_item_list → id1
from_item_list → id2
opt_where  → ε | WHERE expr rel expr
expr       → id3 | id4
rel        → = | < | >

```

Note: Here, ϵ indicates null

[Handwritten signatures]

TEST I Question Paper

BITS, Pilani – Dubai, Dubai International Academic City

III Year SECOND SEMESTER 2009-2010

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

**Course No : CS C362 Course Title: Programming Languages and
Compiler Construction**

Date: 21 Mar., 2010 Sunday Time: 50 minutes Total marks: 50 Weightage: 25%

Data provided are complete. Closed Book. This qn paper has 3 pages.

Answer all Questions.

1. Write the OUTPUT of the following C Program: [10 M]

```
/* Parameter Passing */
#include <stdio.h>
main ()
{
    void e (int xy, int *nq);
    int x[10], i;
    int n = 11;
    for (i = 0; i < 10; i += 1)
        x[i] = 2;
    for (i = 1; i <= 10; i += 1)
    {
        n = n - 1;
        e (x[i - 1], &n);
    }
}

void
e (int xy, int *nq)
{
    int m, p, z;
    m = *nq;
    p = 1;
    z = xy;
    while (m > 0)
    {
        while (!(m % 2))
        {
            m /= 2;
            z *= z;
        }
        m--;
        p *= z;
    }
    printf (" p = %d \n", p + 2);
}
```

PTO

2. Write a SWI-PROLOG program to implement the following RECURRENCE RELATION; Assume that n is ≥ 0 .

$T(n) =$

- $3n^2 + 2n + 10$, for $n=0,1$ or 2
- $T(n-1) + 2T(n-2) + T(n-3)$ for $n > 2$.

Write the output for the following queries/goals:

i) $t(3,X)$.

ii) $t(4,Y)$.

[7+3 M]

3. Write a JAVA program involving *Class Inheritance* for a simple academic application as specified below: [10 M]

- Create a base class **Info** that can store the following attributes of type string [i.e. data items] **weblink** (i.e. the URL), **filename**. This class can contain a *constructor* to set the values for the attributes **weblink** and **filename**. This class contains another *method* to display the **weblink** and **filename**.

- Create a derived class **Academic** that extends the base class. This class can store an attribute **categorycode** of type integer. (Assume that the *categorycode* can have a value 1 or 2 or 3 when an object is created). This class can contain a constructor to set the values for **weblink**, **filename** and **categorycode**. This class contains another *method* to display the **weblink**, **filename**, **categorycode**. It also prints **one** of the following *messages* according to the value of **categorycode**:

If *categorycode*=1, it displays the message, "Higher Education".

If *categorycode*=2, it displays the message, "Professional Body".

If *categorycode*=3, it displays the message, "Symposium".

-Create a Class **Inheritance_Testing**. This class can store the **main** function. Now you create the following three objects for the class **Academic**:

www.bitsdubai.com plcc1.txt 1

www.ieee.org s12.xml 2

www.nitt.edu vortex.txt 3

Now print all these objects along with their appropriate messages.

P.T.O.

4. What are the functions of **Semantic Analyzer & Symbol Table** in a compiler ?
[2+2 M]

5. Give an example for each of the following types of errors: [4 M]
LEXICAL ERROR SYNTAX ERROR SEMANTIC ERROR LOGICAL ERROR

6. Represent the following sets by Regular Expressions, if applicable:

i) { a^2 , a^5 , a^8 , a^{11} , }

[note : (a power n) denotes no of occurrences of a]

Here 'a' is the alphabet.
5 means 'aaaaa'

ii) All strings of digits that contain **no leading zeroes**.

iii) All strings of digits that represent **even numbers**. [2+2+2 M]

7. Explain the following operations on STRINGS and LANGUAGES for the sets L (set of alphabets, upper and lower case) and D (set of digits) :

a) UNION b) KLEENE CLOSURE c) CONCATENATION [2+2+2 M]

QUIZ II

Course No : CS C362 Course Title: Prog. Lang. & Comp. Cons.

Date: 19/4/10 Monday Time: 20 min. Total marks: 30

Weightage: 03% Venue : As per seating arrangement **Closed Book.**

This *question paper* has 3 *pages* Data provided are complete

Use **Back Page** for **rough work only** (*this back page will not be evaluated*)

IDNO:

Name:

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

1. Eliminate all **left recursions** and **common prefixes** (perform left factoring), if any, from the following grammars: [2+2 M]

a) $N \rightarrow Nr \mid M$

b) $N \rightarrow rM \mid rs$

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

3. What is the meaning of each of the following regular expressions in LEX ? 5*2= 10 M

$\wedge x$

$x\$$

$x|y$

x/y

$x\{m,n\}$

QUIZ II

Course No : CS C362 Course Title: Prog. Lang. & Comp. Cons.

Date: 19/4/10 Monday Time: 20 min. Total marks: 30

Weightage: 03% Venue : As per seating arrangement ***Closed Book.***

This *question paper* has 3 *pages* Data provided are complete

Use ***Back Page*** for ***rough work only*** (*this back page will not be evaluated*)

IDNO:

Name:

4.Explain in brief the action of the following *segment* of YACC program below this question (in this page only) : [6 marks]

```
%{
#include <stdio.h>
%}
%token      NUMBER, ")", "(", "
%left "+"
%left "/"
%%
expr:      NUMBER      { $$ = $1; }
        | expr "+" expr  { $$ = $1 + $3; }
        | expr "/" expr  { $$ = $1 / $3; }
        | "(" expr ")"   { $$ = $2; }
;
%%
```

QUIZ II

Course No : CS C362 Course Title: Prog. Lang. & Comp. Cons.

Date: 19/4/10 Monday Time: 20 min. Total marks: 30

Weightage: 03% Venue : As per seating arrangement **Closed Book.**

This *question paper* has 3 *pages* Data provided are complete

Use **Back Page** for **rough work only** (*this back page will not be evaluated*)

IDNO:

Name:

5. a) Write the action of the following LEX Program in two sentences. [4 M]

```
%{
    #include <stdio.h>
    int n=1;
}%

%%
.*\n    { printf("%d %s", n++, yytext); }

%%
```

b) Assume that the input to your program [input is read from file using input redirection < symbol], is the following text, What will be the output of your program? [2 M]

AAAAA

BBBBB

6. What is the difference between LEFTMOST and RIGHTMOST DERIVATIONS? [2 M]

QUIZ I

Course No : CS C362 Course Title: Prog. Lang. & Comp. Cons.

Date: 08/3/10 Monday Time: 20 min. Total marks: 16

Weightage: 08% Venue : As per seating arrangement **Closed Book.**

This question paper has 2 pages Data provided are complete

Use **Back Page** for **rough work** only (this back page will not be evaluated)

IDNO:

Name:

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

1. What are the main features of DECLARATIVE Programming paradigm? [2 M]

2. Mention any two main advantages of Virtual Machines. [2 M]

3. Write a *PICO LISP* program to implement the following RECURRENCE
RELATION: (Assume that n is ≥ 0).

$T(n) =$

- $2n^2 + 2n + 1$, for $n=0,1$.
- $3T(n-1) + 2T(n-2)$ for $n > 1$.

[3 M]

QUIZ I

Course No : CS C362 Course Title: Prog. Lang. & Comp. Cons.

Date: 08/3/10 Monday Time: 20 min. Total marks: 16

Weightage: 08% Venue : As per seating arrangement **Closed Book.**

This question paper has 2 pages Data provided are complete

Use **Back Page** for **rough work only** (this back page will not be evaluated)

IDNO:

Name:

4. Consider the following PICO LISP Program:

```
/* comm.l */
( de comm(n k)
  ( cond ( ( = n k ) 1 )
          ( ( = k 0 ) 1 )
          ( t ( + ( comm( - n 1 ) ( - k 1 ) )
                  ( comm( - n 1 ) k )
                )
          )
  )
)
/* ----- */
```

Write the **result (output)** of each of the following LISP Expressions for the above code:

INPUT	OUTPUT (write answer in this column only)
(comm 5 2)	
(comm 7 3)	
(comm 6 4)	

[3 M]

5. Libraries of functions for Delayed Linking are stored in _____ for LINUX OS

and

_____ for WINDOWS OS.

[2 M]

6. Mention any two properties for BINDING during LANGUAGE IMPLEMENTATION TIME.

[2 M]

7. In PICO LISP, INTERNAL Symbols are all those “normal” symbols, as they are used for _____ and _____.

[2 M]