BITS, Pilani – Dubai. International Academic City, Dubai

III Year SECOND Semester 2008-2009

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

Comprehensive Examination Question Paper

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

Date: 01/06/09 Monday Time: 10 a.m.- 1 Noon Total marks: 80 Weightage: 40%

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

This question paper has 3 pages.

Answer **all** Questions

1. Write separate algorithm(s) to construct the following for any given CFG(context free grammar):

a) NULLABLE SET
b) FIRST SET
c) FOLLOW SET
d) PREDICTIVE PARSING TABLE: (10 Marks)

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

Using LEX and YACC, Check whether a given **"do 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) **relational operators.**

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.

Syntax: **do** *stat* **while** (*exp*) ;

Some valid Inputs are shown here:

```
do { sum = sum + i;  i += 1; } while ( i <= 20 ) ;

do { sum += sum + i;  i -= 2; } while (  i <= 20 ) ;

do { sum *= i; i /= 2; } while (  i <= a ) ;

do  { sum += i;   i = i + 1; } while ( i ) ;
```

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

"YOUR STATEMENT is SYNTACTICALLY CORRECT".

P.T.O.

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]

3. Write a JAVA program to play the game "Fizzbuzz". It counts from 1 to 100, replacing each multiple of 5 with the word "fizz", each multiple of 7 with the word "buzz", and each multiple of both with the word "fizzbuzz". Echo the remaining inputs. [5 marks]

4. Consider a *simple assignment statement*:

$$k := (p+30) + (p - 5) + (r + q)$$

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]

5. Explain in detail the *mark-and-sweep* garbage collection algorithm. [5 marks]

6. Write a SWI-PROGRAM to covert a given input number in a given INPUT BASE to an equivalent number in a specified OUTPUT BASE (like decimal to binary, binary to decimal, octal to binary, binary to octal and so on.). Assume that the input/output bases can be any value between 2 and 10. (you can display results in simple text mode)

Test Scenario (for illustration purpose, given)

IBASE	10	2	10	9	10	8	3
OBASE	2	10	9	10	10	3	8
INPUT	7	111	9	12	5	123	10002
RESULT	111	7	10	11	5	10002	123

[7 marks]

7. Write a PICO LISP program to implement the following function using recursion:

$a_n = (2 * a_{n-1}) + 3$ with $a_0 = 10$ and **n** is a positive integer.

[3 marks]

P.T.O.

8. Write the output generated by the following JAVA program: [5 marks]

```
import java.io.*;
public class C
{
  public static void main (String[] args)
  {
    for (int i = 1; i <= 10; i++)
      {
       System.out.print (ca (i) + " ");
      }
    System.out.println ();
  }
  public static int ca (int n)
  {
    if ( n < 0 ) throw new IllegalArgumentException();
    if (n < 2)
      return 1;
    int sum = 0;
    for (int i = 1; i <= n; i++)
      sum += ca (i - 1) * ca (n - i);
    return sum;
  }
}
```

9. Draw the layout of a typical STACK FRAME (ACTIVATION RECORD) for a function and briefly explain its contents. [5 marks]

10. Explain the following terms w.r.t. LIVENESS ANALYSIS
a) Use b) Def c) Liveness d) Dataflow Equation [5 marks]

11. Give an example for each of the following categories w.r.t CODE OPTIMIZATION:
a) Copy Propagation b) Dead-Code Elimination c) Code Motion
d) Common Sub-expression Elimination e) Reduction in Strength [5 marks]

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

13. Explain the principles w.r.t. BASIC BLOCKS and TRACES. [5 Marks]

14. Write a brief note on Syntax-Directed Definition with inherited attribute (L.in). [3 marks]

15. What are the main functions of RUNTIME SUPPORT ? [2 marks]

BITS, Pilani – Dubai, Dubai International Academic City

III Year SECOND SEMESTER 2008-2009

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

TEST II Question Paper

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

Date: 30 Apr., 2009 Thursday Time: 50 minutes Total marks: 20

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 add the ASCII values of each letter present in the string. 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 VALUE=

((sum of ASCII values of the individual letters present in the string) * 11 + 3) MOD 7

Example : Input String : **A1b**

Hash Value = **((65+49+98) *11 + 3) mod 7 = 1**

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

a) **A2c** b) **D3b** c) **C4d** d) **E5f** e) **F2a** f) **B2e**

Draw the layout of the Symbol Table showing its contents. [3 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) [2 M]

3. Translate the following program segment into Three Address Code (Quadraples):

```
begin
    while ( i < 20)
      begin
          k = k + 2
          j = k + 3
          i = i + 2
      end
    j = j + 5
end
```

Assume that *i,j,k* are all integers whose initial values are zero. [2 marks]

P.T.O.

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

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

Here **n** denotes newline.

Construct an annotated PARSE TREE for the following input expression:

(7 * 2 + 5) * 4 **n** [2.5 M]

5. Find the NULLABLE, FIRST and FOLLOW sets for the following CFG and then Construct the PREDICTIVE PARSING TABLE: (8 marks)

$S \rightarrow H$
$S \rightarrow I$
$H \rightarrow A$;
$H \rightarrow$;
$I \rightarrow$ **if** (A) S
$A \rightarrow B$
$B \rightarrow CGF$
$C \rightarrow D$
$D \rightarrow E$
$E \rightarrow$ **a**
$E \rightarrow F$
$F \rightarrow$ **4**
$G \rightarrow =$
$L \rightarrow \epsilon$

Note: Here, ϵ indicates null

6. Show the steps in evaluating the following expression in an ABSTRACT STACK MACHINE:

a := (c + d) * (a + b) + 2

[1.5 M]

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

BITS, Pilani – Dubai, Dubai International Academic City

III Year SECOND SEMESTER 2008-2009

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

TEST I Question Paper

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

Date: 22 Mar., 2009 Sunday Time: 50 minutes Total marks: 20

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

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] = 1 + n;
      e (x[i], &n);
      n = n * 2 + 2;
    }
}
void
e (int xx, int *nn)
{
  int m, z;
  m = *nn + 4;
  z = xx + 4 + m;

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

2. What are the ARITHMETIC OPERATORS (other than + - * /) supported in SWI-PROLOG ?

[1.5 marks]

[P.T.O.]

3. *Write a SWI-PROLOG program* to implement the following recurrence relation:

$T(n) = T(n-1) + (n-1)n$
given that $T(1)=0$.

What will be the result when $n = 7$? [4 marks]

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

a) $N \rightarrow Nr \mid M$

[1.5 M]

b) $N \rightarrow rM \mid rs$

[1.5 M]

5. What is Regular Definition ? Give an example. [2 M]

6.Write the meaning of the following regular expressions in LEX :

a) r_1 / r_2

b) r?

c) $

d) ^ [2 M]

7 a) .Distinguish between Syntactic Error and Semantic Error. [1 M]

b). According to notational conventions for context-free grammar, what symbols can you consider as terminals ? [1.5 M]

BITS, Pilani – Dubai, Academic City, Dubai.
IIII Year CS Second Semester 2007-2008
Degree: B.E. Hons. Branch: C.S.
QUIZ III
Course No : CS UC362 Course Title: Prog. Langs. & Compiler Const.
Date: 06, April, 2009 Wednesday Time: 15 min. Total marks: 05
Weightage: 5% Venue : As per seating arrangement ***Closed Book***.
This question paper has 2 pages
Data provided are complete.
Mobile phones not allowed. Use back-page for **rough work** only.
IDNO: Name:

Write answers in the space provided in question paper. Answer all questions.
_____ means fill up the blanks (complete the sentence) with as many required words.

1. What is the action of the following statement w.r.t. IR Tree? 1 M
   CJUMP(o, e_1, e_2, t, f)

2. The following identity w.r.t. IR Tree can be rewritten as: [1 M]

   ESEQ(s_1, ESEQ(s_2,e)) _____

3. A TRACE is _____

1 M

BITS, Pilani – Dubai, Academic City, Dubai.
IIII Year CS Second Semester 2007-2008
Degree: B.E. Hons. Branch: C.S.
QUIZ III
Course No : CS UC362 Course Title: Prog. Langs. & Compiler Const.
Date: 06, April, 2009 Wednesday Time: 15 min. Total marks: 05
Weightage: 5% Venue : As per seating arrangement ***Closed Book***.
This question paper has 2 pages
Data provided are complete.
Mobile phones not allowed. Use back-page for **rough work** only.
IDNO: Name:

4. What is ENCAPSULATION in OOP? 1 M

5. What does a STACK FRAME/ACTIVATION RECORD consist of ? 1 M

BITS, Pilani – Dubai, Academic City, Dubai.
III Year CS Second Semester 2008-2009
Degree: B.E. Hons. Branch: C.S.
QUIZ II
Course No : CS C362 Course Title: Prog. Langs. & Compiler Const.
Date: 31, Mar., 2009 Tuesday Time: 15 min. Total marks: 05
Weightage: 5% Venue : As per seating arrangement ***Closed Book***.
This question paper has 2 pages [use back page for rough work]
Data provided are complete.

IDNO: Name:

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

1. Write YACC SOURCE in standard form for the following CFG: 3 M.

$S \rightarrow 1A$
$A \rightarrow 0S \mid 0 \mid 1S$

BITS, Pilani – Dubai, Academic City, Dubai.
III Year CS Second Semester 2008-2009
Degree: B.E. Hons. Branch: C.S.
QUIZ II
Course No : CS C362 Course Title: Prog. Langs. & Compiler Const.
Date: 31, Mar., 2009 Tuesday Time: 15 min. Total marks: 05
Weightage: 5% Venue : As per seating arrangement ***Closed Book.***
This question paper has 2 pages [use back page for rough work]
Data provided are complete.

IDNO: Name:

---

2. What are the conflicts in Parsing using YACC ? How does YACC handle them ? [2 marks]

BITS, Pilani – Dubai, Academic City, Dubai.
III Year Second Semester 2008-2009
Degree: B.E. Hons. Branch: C.S.
QUIZ I
Course No : CS UC362 Course Title: Prog. Lang. & Comp. Cons.
Date: 24/2/09 Tuesday Time: 15 min. Total marks: 05
Weightage: 5% Venue : As per seating arrangement ***Closed Book***.
This question paper has 2 pages Data provided are complete
Use Back Page for rough work only

IDNO: Name:

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

1. Consider the following PICO LISP Program:

```
 (de a(n)
( if (= n 1)
  1
( +  ( *  3   (a(- n 1))  )  4 )
))
```

Write the result (output) of each of the following LISP Expressions for the above code:
i) **(a 3)** ii) **(a 4)** iii) **(a 5)** iv) **(a 6)**

[2 marks]

2. What is a DECLARATIVE LANGUAGE in programming paradigm? [0.5 M]

3. What is the purpose of INTERNAL SYMBOL in PICO LISP ? [0.5 M]

BITS, Pilani – Dubai, Academic City, Dubai.
III Year Second Semester 2008-2009
Degree: B.E. Hons. Branch: C.S.
QUIZ I
Course No : CS UC362 Course Title: Prog. Lang. & Comp. Cons.
Date: 24/2/09 Tuesday Time: 15 min. Total marks: 05
Weightage: 5% Venue : As per seating arrangement ***Closed Book***.
This question paper has 2 pages Data provided are complete
Use Back Page for rough work only
IDNO: Name:

---

4. What are the advantages of a VIRTUAL MACHINE (like JVM) ? [1 M]

5. What properties are BOUND at LANGUAGE IMPLEMENTATION TIME ? [1 M]