BIRLA INSTITUTE OF TECHNOLOGY & SCIENCE, PILANI
HYDERABAD CAMPUS
FIRST SEMESTER 2019 – 2020
PRINCIPLES OF PROGRAMMING LANGUAGES (CS F301) – MID SEM EXAM

Date:14/11/2019 **Weightage: 25% [50 Marks]**
Duration: 90mins **Type: Closed Book**

Please note: 1. All parts of the questions have to be answered consecutively.
2. Your answers should be brief.

QI. Features of a Programming Language

A. Give a feature of C, C++, or Java that illustrates orthogonality. Give a feature different from the one discussed in the text that illustrates non-orthogonality.? **[2 M]**

B. Given the following input string in C ***printf("sum is :%d",a+b);*** what sequence of <lexeme, token> pairs are returned by the lexical analyzer. **[3 M]**

C. Assume that you are given a rudimentary programming language which contains only four operators, (+,−,abs and div) .+ and − have their usual meanings, while div (a, b) returns the quotient of a / b and abs (a) returns the absolute value of a. **Write a C -style function max (a, b)** that takes two integers a and b as input and returns the maximum of the two. **[5 M]**
Note that you can only use the operators provided; in particular, the constructs "if", "while", and "for" are not available. [Hint: Use the concept of functional programming language)

Q2. Syntax of programming languages

A. A C/C++/Java for-loop statement, the following is an example for statement: **[5 M]**

```
for (int k = 0, m = 100; k < n; k++, m++) {
        x = x + 1;
        y = y – 1;
}
```

where "int k = 0, m = 100" is an variable declaration, in which "int" is a type name, "k" and "m" are identifiers, and "0" and "100" are literals. If there is no appearance of "int", "k = 0, m = 100" are a sequence of assignments. Also, "k < n" is an expression, "k++; m++" are also expressions, and "x=x+1;y=y+1;" is a statement list.
Assume the following non-terminals are given/available:
<type>, <id>, <literal>, <assign>, <expr>, and <stmt_list>.
Write a EBNF description for the for statement considering <for> as the Nonterminal.

B. Give a BNF for declaring structures in C language and also substantiate your solution with a parse tree. **[10 M]**

Q3. Data Types **[5+2=7M]**

Shristy is working on designing an efficient way of storing a symmetric 2D matrix of size N×N where elements above the principal diagonal are zero's. Hence the elements in the lower triangular matrix will only be stored including the diagonal elements using row major ordering. The following is an example of the array. The elements stored in indices that are shown in bold will be stored using row major ordering.

1	0	0	0
5	**6**	0	0
8	**9**	**6**	0
10	**8**	**5**	**1**

A. Formulate the effective address calculation to access each element of the array A[i][j] for Shristy?

B. Show the runtime descriptor that will be generated for storing the new modified array.

Q4. Type systems **[5+3=8M]**

A. For the input expression ***while(a<b) { c=a+b; }***

i. Give the required type rules required for deriving the above while statement where a : int b : int c : int

ii. Construct a derivation tree to give a type for the input expression.

B. Given the following C program: **[2.5M]**

```
#include <stdio.h>
#define A 47
void main() {
int B = 23;
int C = 17;
scanf("%d",&B);
if (B > 5)
C = A;
else
C = func1(A);
printf("%d",C);
}
```

Given the following choices ranging form a-d. For each question pick the correct answer

a) Language design b) Language implementation c) Compile d) Run

i. At what time is the value of A bound?

ii. At what time is the value of B bound?

iii. At what time is the value of C bound?

iv. At what time is the range of int values determined?

v. At what time is the keyword void bound to its meaning?

5. Names Type Binding **[2.5M]**

Identify the type of errors in the following Java program as lexical, syntax, static semantic, dynamic semantic or logic.

```
public int gcd ( int v# )
{ int z = value
  y = v;
  while ( y >= 0 )
  { int t = y;
    y = z % y;
    z = t;
  }
  return y; }
```

********** *That's all folks* **********