Computer Science and Engineering Department, SVNIT - Surat
End Semester Examination - May - 2022
B.Tech. III – Semester - VI
Principles of Programming Languages (CS302)

Date: 10th May 2022 **Time:** 12:00 PM to 03:00 PM **Max Marks:** 50

1. Write PROLOG program for the following:

   a) To implement an interactive code for finding roots of a quadratic equation using predicate ***quad_root(real, real, real, real)***. Here ***quad_root(A,B,C,D)*** is with three coefficients A, B, C and D as B^2-4AC. Three coefficients must be entered by user. 03

   b) To develop program for finding the first 20 Fibonacci numbers. Here 1st and 2nd numbers are 1 each and each successive numbers is calculated using ***fib (n) = fib (n-1) + fib (n-2)***. Implement with predicate ***fib (integer, real) such that fib (1, 1) and fib (2, 1).*** 03

   c) To implement ***add_up_list(L, K)*** that asserts that ***L*** and ***K*** are lists of integers where every element in ***K*** is the sum of all the elements in ***L*** up to the same position. Precondition: L is an instantiated variable. e.g. ***add_up_list([1], K). will produce K = [1], add_up_list([1, 2], K). will produce K = [1, 3], add_up_list ([1, 3, 5, 7], K). will produce K = [1, 4, 9, 16]*** 03

2. Write a PROLOG program to have dynamic database along with goals for meeting some sample queries. 03

   OR

   Write a PROLOG program to have compound objects along with goals for meeting some sample queries.

3. Write a PROLOG program to replace the occurrence of a specific word by another word throughout a specified file. Implement the predicate ***replace (Old, New, A, Anew)***, which replaces occurrences of the ***Old*** by ***New*** in the string bound to ***A***, the resultant new string ***Anew***. Here ***replace (symbol, symbol, string, string).*** 04

4. (i) Consider the following clauses for the predicate **do**: 03

```
do ( [H|_], H ) :- H < 0, !.
do ( [H|_], H ) :- H > = 0.
do ( [_|T], H1) :- do (T, H1).
```

Given the goal: *do([1,2,3,4,5,-5,6,7,8],X)* What will be instantiations of X? (Justify your answer.)

(ii) The following procedure computes the maximum value in a list of numbers:

```
max ( [X] , X).
max( [X | Rest], Max) :-
  max( Rest, MaxRest),
  (MaxRest >= X, !, Max = MaxRest
;
  max = X).
```

Max = X

Transform this into a tail-recursive procedure.

1,+3+6+10

([2,3],2)
[3,4,5] 3
[5],4

5. Here is a structure declaration: 05

```
struct box
{
char maker[40];
float height;
float width;
float length;
float volume;
};
```

1 2 3, 4 5
3, 3, 4, 5
6 4 5
10 5
15

a. Write a function that passes a box structure by value and that displays the value of each member.

b. Write a function that passes the address of a box structure and that sets the volume member to the product of the other three dimensions.

c. Write a simple program that uses these two functions.

d. Write a function that has a reference to a box structure as its formal argument and displays the value of each member (Separate program point d & e).

e. Write a function that has a reference to a box structure as its formal argument and sets the volume member to the product of the other three dimensions.

6. Design a class named ***Fan*** to represent a fan. The class contains: 04

a. Three constants named ***SLOW***, ***MEDIUM*** and ***FAST*** with values 1, 2 and 3 to denote the fan speed.

b. An ***int*** data field named ***speed*** that specifies the speed of the fan (default SLOW).

c. A ***boolean*** data field named ***f_on*** that specifies whether the fan is on (default false).

d. A ***double*** data field named ***radius*** that specifies the radius of the fan (default 4).

e. A data field named ***color*** that specifies the color of the fan (default blue).

f. A no-arg constructor that creates a default fan.

g. A parameterized constructor initializes the fan objects to given values.

h. A method named ***display ()*** will display description for the fan. If the fan is on, the ***display ()*** method displays speed, color and radius. If the fan is not on, the method returns fan color and radius along with the message "fan is off".

Write a test program in C++ that creates two Fan objects. One with default values and the other with medium speed, radius 6, color brown, and turned on status true. Display the descriptions for two created Fan objects.

7. Write a complete program in C++ to accept N integer numbers from the command line. Raise and handle exceptions for following cases: 04

- when a number is negative
- when a number is evenly divisible by 10
- when a number is greater than 1000 and less than 2000
- when a number is greater than 7000

Skip the number if an exception is raised for it, otherwise add it to find total sum.

8. You need to design a Vending Machine which 04

- Accepts coins of 1, 5, 10, 25 Cents i.e. penny, nickel, dime, and quarter.
- Allow user to select products Coke (25), Pepsi (35), Soda (45)
- Allow user to take refund by canceling the request.
- Return selected product and remaining change if any
- Allow reset operation for vending machine supplier.

Designing á vending machine in C++, you have to use basics of language e.g. Encapsulation, Polymorphism or Inheritance and also use subtle details such as abstract class and interface.

9. Create a class in C++ coordinate containing x, y and z private data members. Perform operations for incrementing, adding and comparing objects by overloading ++, += and = = operators respectively. Define necessary functions to set and display the variables. 03

10. Consider the following program, written in JavaScript-like syntax: 03

```
// main program
var x, y, z;
function sub1() {
var a, y, z;
. . .
}
function sub2() {
var a, b, z;
. . .
}
function sub3() {
var a, x, w;
. . .
}
```

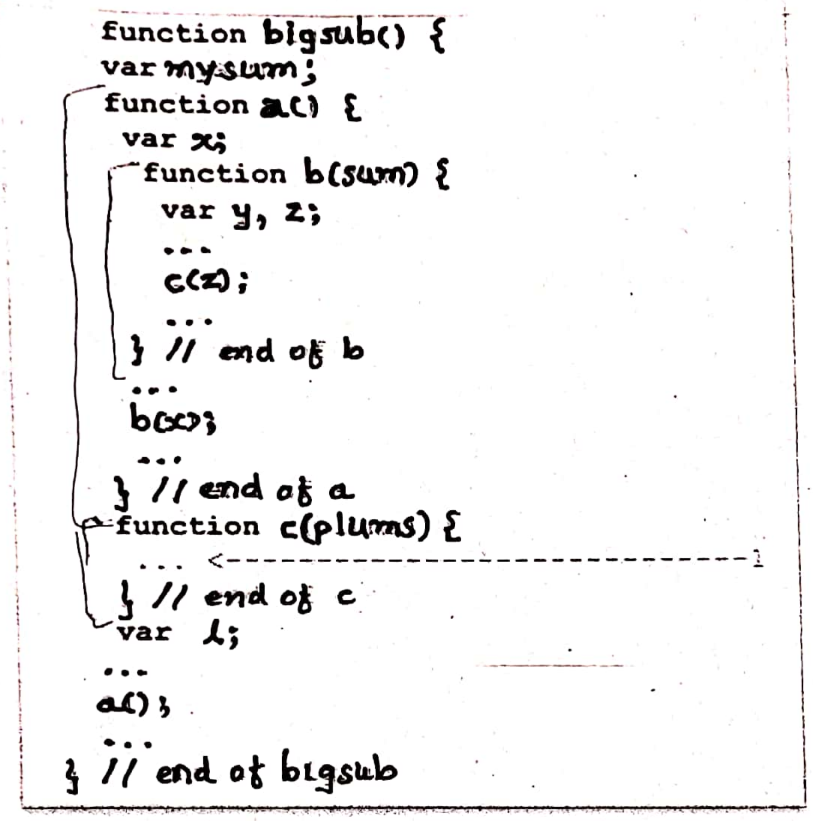
Given the following calling sequences and assuming that dynamic scoping is used, what variables are visible during execution of the last subprogram activated? Include with each visible variable the name of the unit where it is declared.

a. main calls sub1; sub1 calls sub2; sub2 calls sub3.

b. main calls sub1; sub1 calls sub3.

c. main calls sub2; sub2 calls sub3; sub3 calls sub1.

11. Show the stack with all activation record instances, including static and dynamic chains, when execution reaches position 1 in the following skeletal program. Assume Bigsub is at level 1. 03



```
function bigsub() {
var mysum;
function a() {
 var x;
  function b(sum) {
   var y, z;
   ...
   c(z);
   ...
  } // end of b
  ...
  b(x);
  ...
 } // end of a
 function c(plums) {
  ... <------------------------------1
 } // end of c
 var l;
...
a();
...
} // end of bigsub
```

12. (i) Explain the statement "The private members of the base class are indirectly available to the derived class". 05

(ii) Write syntax of partial specialization and explicit specialization in template function.

(iii) Assuming *txt_size* is a function that takes no arguments and returns an ***int*** value, which of the following definitions are illegal? Explain why.

unsigned buf_size = 1024;

a. int ia[buf_size]; b. int ia[4 * 7 - 14];

c. int ia[txt_size ()]; d. char st[11] = "fundamental";

(iv) What does the following program do? Write output/ single line answer.

```
const char ca[] = {'h', 'e', 'l', 'l', 'o'};
const char *cp = ca;
while (*cp) {
        cout << *cp << endl;
        ++cp;
}
```