National Institute of Technology, Silchar
End-Semester (UG) Examination, May' 2022

Subject Code: CS306.
Semester: 6th.
Duration: Two hours

Subject: Principles of Programming Languages
Department: Computer Science and Engineering
Total Marks: 50

Answer questions 1 – 4, and either 5 or 6

	Question	Marks	CO
1(a)	State the different programming paradigms.	2	CO-3
(b)	Give a salient feature of each programming paradigm.	4	CO-3
(c)	For each of the programming paradigms give an example of an appropriate programming language.	2	CO-3
(d)	For each of the programming languages give a suitable application domain.	2	CO-3
2	Given a programming language that is designed for some application program that performs frequent column operations on a matrix of real numbers such that to perform efficient execution of the programs written in this language, the storage representation of the matrix should be in the column-major form. Consider A : **array** $[L_1..U_1, L_2..U_2]$ **of** real		
(a)	Formulate the virtual origin (VO) given base address = α and size of real is four bytes. Also find *lvalue* of $A[i, j]$.	1+1	CO-1
(b)	Explain with example the two types of coercion found in programming languages.	4	CO-1

3	`main()`
	`{`
	`int x, y;`
	`scanf("%d %d", &x, &y);`
	`LABEL1: if(x == y)`
	`goto LABEL3;`
	`if(x > y)`
	`goto LABEL2;`
	`y = y - x;`
	`goto LABEL1;`
	`LABEL2: x = x - y;`
	`goto LABEL1;`
	`LABEL3: printf("Result = %d",x);`
	`}`		

(a)	Draw the flowchart for the above program. Mark the goto arcs in your flowchart	$3 + 1\frac{1}{2}$	CO-2
(b)	From the flowchart obtain the program graph using the three classes of nodes (Functional, Decision, and Join) only. Give the number of different classes of nodes.	$3 + 1\frac{1}{2}$	CO-2
(c)	Using the concept of the structure theorem apply the transformations of structured programming to the programm graph obtained in (b) and generate the modified program. Clearly show all the node and arc labeling.	4 + 2	CO-2
(d)	Using the modified program in (c) write the program without `goto` statements.	4	CO-2
(e)	What is the program computing?	1	CO-2

	Question	Marks	CO

4	Following is a recursive call to generate the nth Fibonacci number (0, 1, 1, 2, 3, ...),
	`int Fibonacci(int n) {`
	`  if ( n == 0 )`
	`  return 0;`
	`  else if ( n == 1 )`
	`  return 1;`
	`  else`
	`  return ( Fibonacci(n-1) + Fibonacci(n-2) );`
	`}`		

(a)	Give the maximum number of activation records that will be active at any time when a call is made for this subprogram with n = 6.	1	CO-2
(b)	Show using the subprogram control structure why such a recursive call is computationally expensive.	3	CO-2
5	Suppose you are designing a programming language that provides support for complex numbers such that the programmer can use the complex number data objects in the same way as the programmer uses any elementary data type of the language. Answer the following to explain how you will provide such facility in the language.		
(a)	Give the specifications along with the corresponding syntax for the declaration of the complex number data type so that all specifications are met.	2	CO-4
(b)	Give the signature of the following operations that can be performed on the complex number data objects 1. Assignment 2. Addition 3. Multiplication	3	CO-4
(c)	Clearly provide the storage representation of the complex number type data objects.	2	CO-4
(d)	Give the implementation of the three operations mentioned above as subprograms.	3	CO-4
	OR		
6	Design the part of a programming language that provides support for rational numbers.		
(a)	Give specification and Implementation of the rational number as an abstract data type with encapsulation by subprograms. Your specification and Implementation should include the following operations which the user will be able to perform by invoking these encapsulated subprogram calls 1. Assignment 2. Check whether two rational numbers are equal 3. Addition	4	CO-4
(b)	Give the implementation of the three operations mentioned above as subprogram.	3 × 2	CO-4