

	Course Name:	Theory of Programming Languages	Course Code:	CS 507
	Program:	CS	Semester:	Spring 2018
	Duration:	150 Minutes	Total Marks:	90
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	Section:	ALL	Page(s):	7
	Exam Type:	Final		

Student : Name: _____ **Roll No.** _____

Instruction/Notes:

- 1. Solve in the space provided. You may use rough sheet for working, but attach the worksheet to get any marks.**
- 2. Answer ALL questions.**
- 3. Cheat sheet is not allowed**

1. [5] Given the following program of a language called crypt. What is the output of the program if dynamic scoping is used? What is the output if static scoping is used? Main is the entry point in the program:

Program	Output Dynamic Scoping	Output Static Scoping
<pre> Procedure main{ Integer X = 10; Procedure sub1 { X = X + 1; Print("in sub1, X=" X); X = 5; } Procedure sub2 { Integer X = 30; Call sub1; X = X + 2; Print("in sub2, X=" X); } X = 20; Call sub2; Call sub1; Print("in main X = "X); }</pre>		

2. [5] A language that supports **explicit (not implicit) heap dynamic variables and strong (not weak) type**. Main is the entry point in the program:

```

Program main{
  Integer myIntPtr;

  Real myRealPtr;

  Variable1 = 4.3;

  myIntPtr = new Integer;

  myRealPtr = new Real;

  myIntPtr = 5+107.8;

  myRealPtr = 5.6777 * 3.145;

  myIntPtr = myRealPtr;

}
```

Will there be any compile time or runtime errors in the above code (assuming Integer and Real are built in structured types). If there are any error, point out it and write clearly the reason for error. If it is correct, tell the reason also. Write against each line.

3. [10] You are given the following rules for the declaration of variables in a programming language:

<declaration> → <type><identifier>
<type> → integer | float | bool
<identifier> → <letter> | <identifier><letter>
<letter> → b | i | f

You have to write attribute grammar for the above to enforce the following rules (describe the attributes clearly that you define):

- If type is **integer**, then identifier name should begin with **i**
- If type is **float** then identifier name should begin with **f**
- If type is **boolean** then identifier name should begin with **b**
- Total number of i in the identifier name of type integer should be **at most 3**.

4. [20] Short Question / Answers. Answer should be maximum two to three lines.

- a. [2]What is the difference between rectangular and jagged arrays?
- b. [2]Describe two design issues for Record types?
- c. [2]Define the diamond problem? How is the problem handled in C/C++?
- d. [2]Evaluate with respect to readability and writability the fact that variable names in C++ and Java are case-sensitive.
- e. [2]List one advantage and one disadvantage of Dynamic Type Binding?
- f. [2]Evaluate subranges w.r.t. readability and reliability?
- g. [8] Given the following predicate in prolog:
f(X,0,1).
f(X,N,P) :- N > 0, N1 is N-1, f(X, N1, P1), P is P1 * X.
 - a. For the above predicate determine the value of P when the following query is given f(2,1,P)?
 - b. Determine the value of P when the following query is given f(2,3,P)
 - c. What does the above function do?

5. [10] Write a program in Prolog to calculate the factorial of a number

6. [5 + 5 + 5 + 5 + 5]

- a. Discuss the union types in C++ and Ada. Which is better and why?
- b. How do Ada and Cobol differ by syntax and semantics in referencing a record element? Give an example of each?
- c. Declare a two dimensional array in C# which has 5 rows and the rows 1, 2, 3, 4, and 5 have 6, 8, 2, 1 and 7 columns respectively.

- d. Write down a class in java named Hotels with 4 abstract functions named *SingleRoom*, *Suite*, *Lunch*, *Dinner*. Make another class named PearlContinental that inherits from this class in which these abstract functions are implemented. In the implementation of the functions, simply display the following string:
In function *SingleRoom* display the following text: The rate of single room in PC is 235\$.
In function *Suite* display the following text: The rate of suite in PC is 500\$.
In function *Lunch* display the following text: The rate of lunch in PC is 100\$.
In function *Dinner* display the following text: The rate of dinner in PC is 120\$.

- e. Compare Procedural v/s Functional Programming Languages.

7. [10]

Consider the following table; you are required to discuss the differences between C++ and JAVA with respect to given points

a. Calling Static Data members and functions

b. Automatic type conversions

c. Conditional expression evaluation

d. Destructors

e. Multiple Inheritance

8. [5] Is it possible to find for every context free language, a grammar such that all of its productions are of the form $A \rightarrow BCD$ or $A \rightarrow a$? Give a proof or a counter example