

MSc Computer Science(2019-2024)
Paradigm of Programming Language

Semester I	Subject Code: MS11901	Lectures: 60
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Learning Outcomes:

After successfully completing the course students will be able to

- develop an in-depth understanding of functional, logic, and object-oriented languages.
- analyze semantic issues associated with function implementations, including variable binding, scoping rules, parameter passing, and exception handling.
- be familiar with design issues of object-oriented and functional languages.
- be familiar with language abstraction constructs of classes, interfaces, packages, and procedures.
- understand the Scala programming language



MSc Computer Science Syllabus First Year (2019-2024)

Paradigm of Programming Language






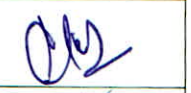

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Objectives:

The syllabus aims in equipping students with,

- the strengths and weaknesses of programming languages for effective and efficient program development,
- the principles underlying the programming languages enabling to learn new programming languages,
- various programming paradigms,
- the issues involved in programming language design and implementation,

Unit 1: Introduction	02
Ch 1. Introduction to the programming languages <ul style="list-style-type: none"> • History and need of various types of Programming Languages(PL). • Types of programming languages(PL). • Characteristics of programming languages PL. • Syntax, Semantics, Pragmatics Analysis of programming languages. 	
Unit 2:Non-Imperative Programming Models: Functional Logic Languages	10
Ch 2. Functional Programming in Scala <ul style="list-style-type: none"> • Strings • Numbers • Control Structures • Classes and Properties 	10

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Dr. ManishaBharambe(Subject Expert)	
Dr. JyotiYadav(Subject Expert)	
Mr. Vishal Salke(Industry Expert)	
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Prof. AshwiniKulkarni (Chairman and Internal Faculty)	
Prof. Smita Borkar (Internal Faculty)	



- Methods
- Objects
- Functional Programming
- List, Array, Map, Set

Unit 3: Scope and control flow in programming languages.


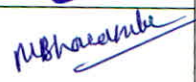
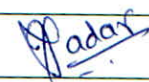



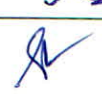
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Ch 3. Names, Scopes, and Bindings

- The Notion of Binding Time
- Object Lifetime and Storage Management
- Static Allocation, Stack-Based Allocation, Heap-Based Allocation, Garbage Collection
- Scope Rules .
- Static Scoping, Nested Subroutines, Declaration Order, Dynamic Scoping The meaning of Names in a Scope .
- Aliases, Overloading, Polymorphism and Related Concepts The Binding of Referencing Environments
- Subroutine Closures, First-Class Values and Unlimited Extent, Object Closures, Macro Expansion.








Ch 4. Control Flow

- Expression Evaluation
 - Precedence and Associativity, Assignments, Initialization, Ordering Within Expressions,
 - Short-Circuit Evaluation.
- Structured and Unstructured Flow
 - Structured Alternatives goto.
- Sequencing.
 - Selection Short-Circuited Conditions, Case/Switch Statements.
- Iteration
 - Enumeration-Controlled Loops, Combination Loops, Iterators, Controlled Loops.
- Iteration and Recursion, Applicative- and Normal-Order evaluation.

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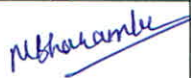
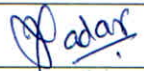






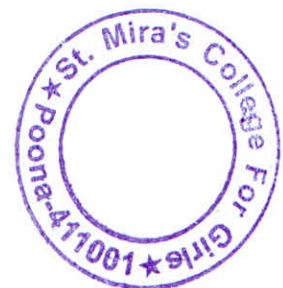
Unit 4: Datatypes	12
<ul style="list-style-type: none"> ➤ Ch 5. Datatypes • Primitive Data Types • Numeric Types <ul style="list-style-type: none"> ➤ Integer, Floating point, Complex, Decimal, Boolean Types, • Character Types • Character String Types <ul style="list-style-type: none"> ➤ Design Issues ➤ Strings and Their Operations ➤ String Length Operations ➤ Evaluation • Implementation of String types • User defined Ordinal types • Enumeration types <ul style="list-style-type: none"> ➤ Designs ➤ Evaluation • Subrange types <ul style="list-style-type: none"> ➤ Ada's design : Example ➤ Evaluation ➤ Implementation of used defined ordinal types • Array types <ul style="list-style-type: none"> ➤ Design issues ➤ Arrays and indices ➤ Subscript bindings and array categories ➤ Heterogeneous arrays ➤ Array initialization ➤ Array operations ➤ Rectangular and Jagged arrays ➤ Slices ➤ Evaluation ➤ Implementation of Array Types ➤ Associative Arrays & implementation 	12

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<ul style="list-style-type: none"> • Record type <ul style="list-style-type: none"> ➤ Definitions of records . ➤ References to record fields . ➤ Operations on records . ➤ Evaluation . ➤ Implementation of Record types . • Pointer and Reference Types. <ul style="list-style-type: none"> ➤ Design issue ➤ Pointer operations . ➤ Pointer problems. ➤ Dangling pointers ➤ Lost heap dynamic variables • Comparison of Pointers in C and C++ • Reference types • Evaluation . • Implementation of pointer and reference types <ul style="list-style-type: none"> ➤ Representation of pointers and references Solution to dangling pointer problem. 	
<p>Unit 4: Subroutines and Control Abstraction</p>	<p>14</p>
<p>Ch 6 . Subroutines</p> <ul style="list-style-type: none"> • Fundamentals of Subprograms Design Issues for subprograms . • Local Referencing Environments . • Parameter-Passing Methods . • Parameters that are Subprograms . • Overloaded Subprograms . • Generic Subroutines <ul style="list-style-type: none"> ➤ Generic Functions in C++ . ➤ Generic Methods in Java . ➤ Design Issues for Functions. ➤ User-Defined Overloaded Operators . ➤ Coroutines. ➤ The General Semantics of Calls and Returns . ➤ Implementing “Simple” subprograms. ➤ Implementing Subprograms with Stack-Dynamic Local Variables . ➤ Nested Subprograms ,Blocks,Dynamic scope 	<p>07</p>

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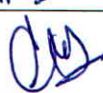
Ch 7. Data Abstraction and Object Orientation

- **Object-Oriented Programming**
- **Encapsulation and Inheritance**
- Modules, Classes, Nesting (Inner Classes), Type Extensions, Extending without Inheritance
- **Initialization and Finalization**
 - Choosing a Constructor, References and Values, Execution Order, GarbageCollection
- **Dynamic Method Binding**
 - Virtual- and Non-Virtual Methods, Abstract Classes, Member Lookup,
 - Polymorphism, Object Closures
- **Multiple Inheritance**
- Semantic Ambiguities, Replicated Inheritance, Shared Inheritance,
- Mix-In Inheritance

07

References books

1. Kaufmann Publishers, An Imprint of Elsevier *Scott Programming Language Pragmatics*, ISBN 9788131222560.
2. Pearson Education Robert W. Sebesta, *Concepts of Programming*
3. O'Reilly Publication Alvin Alexander *Scala Cookbook*

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