MSc Computer Science Syllabus First Year (2018-2023)
Principles of programming language

Semester I **Subject Code: MS11801** **Lectures: 60**

Objectives:

The syllabus aims in equipping students with,

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

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Unit 1: Introduction **02**

Ch 1. Introduction to the programming languages

- 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 **14**

Ch 2.Basic LISP Primitives

- Basic LISP Primitives (FIRST, REST, SETF, CONS, APPEND, LIST,
- NTHCDR, BUTLAST,LAST, LENGTH, REVERSE, ASSOC) **06**
- Procedure definition and binding, DEFUN, LET
- Predicates and Conditional,
- EQUAL, EQ, EQL, =, MEMBER, LISTP, ATOM, NUMBERP, SYMBOLP, NIL, NULL, IF, WHEN, UNLESS, COND, CASE
- Procedure Abstraction, Recursion.
- Arrays.

BOS Members:

Dr. ReenaBharati(Subject Expert)

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Dr. JyotiYadav(Subject Expert)

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Ch 3. Introduction to Turbo Prolog **08**

- facts, Objects and Predicates, Variables,
- Using Rules, controlling execution fail and cut predicates.
- Recursion, Compound objects, List, Strings.

Unit 3: Scope and control flow in programming languages. **10**

Ch 4. Names, Scopes, and Bindings **05**

- 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 5. Control Flow **05**

- Expression Evaluation
  - Precedence and Associativity, Assignments, Initialization, Ordering WithinExpressions,
  - 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.
- Recursion.
- Iteration and Recursion, Applicative- and Normal-Order evaluation.

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Unit 3: Datatypes **10**

- **Ch 6. Datatypes** **10**
  - Primitive Data Types
  - Numeric Types
  - Integer, Floating point, Complex, Decimal, Boolean Types,
  - Character Types
- Character String Types
  - Design Issues
  - Strings and Their Operations
  - String Length Operations
  - Evaluation
- Implementation of Character String types
- User defined Ordinal types
- Enumeration types
  - Designs
  - Evaluation
- Subrange types
  - Ada's design : Example
  - Evaluation
  - Implementation of used defined ordinal types
- Array types
  - 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
  - Implementing associative arrays.

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- Record type
  - Definitions of records .
  - References to record fields .
  - Operations on records .
  - Evaluation .
  - Implementation of Record types .
- Pointer and Reference Types.
  - 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
  - Representation of pointers and references
  - Solution to dangling pointer problem.

Unit 4: Subroutines and Control Abstraction **12**

Ch 7 . Subroutines **06**

- Fundamentals of Subprograms Design Issues for subprograms .
- Local Referencing Environments .
- Parameter-Passing Methods .
- Parameters that are Subprograms .
- Overloaded Subprograms .

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- **Generic Subroutines**
  - 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 .
  - Implementing Dynamic Scoping .

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Ch 8. Data Abstraction and Object Orientation

- **Object-Oriented Programming**
- **Encapsulation and Inheritance**
- Modules, Classes, Nesting (Inner Classes), Type

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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

References books

1. Kaufmann Publishers, An Imprint of Elsevier *Scott Programming Language Pragmatics,* ISBN 9788131222560.
2. Robert W. Sebesta, Pearson Education.*Concepts of Programming Languages,* Eighth Edition .
3. Carl Townsend ,*Introduction to Turbo Prolog* .
4. Patrick Henry Winston & Berthold Klaus Paul Horn 3rd edition- *LISP* . (BPB Publication)
5. M. Gabbrielli, S. Martini, Springer ,*Programming Languages: Principles andParadigms,*ISBN: 9781848829138.

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