Savitribai Phule Pune University

(Formerly University of Pune)

Three Year Degree Program in

'Industrial Mathematics with Computer Applications'

(Faculty of Science & Technology)

Revised Syllabi for

M.Sc. (Industrial Mathematics with Computer Applications)

Part-II

(For Colleges Affiliated to Savitribai Phule Pune University)

Choice Based Credit System Syllabus

To be implemented from the Academic Year 2020-2021

Title of the Course: M. Sc. (Industrial Mathematics with Computer Applications)

Preamble:

Savitribai Phule Pune University has decided to change the syllabi of various faculties from June, 2019. M.Sc. (Industrial Mathematics with Computer Applications) course syllabus is revised to cater to the needs of credit based-semester and grading system. The changing scenario of higher education in India and abroad is taken into consideration to make this syllabus more oriented towards the applications of Mathematics and Computer Science in Research and Industry. The syllabus encompasses the subjects related to Industrial Mathematics, Core Computer Subjects as well as the Emerging Technologies in Computer Science. Theory Courses will create the foundation for the development of logical thinking and the Practical Courses gives hands on experience towards the Industrial Requirements.

Taking into consideration the rapid changes in science and technology and new approaches in different areas of Mathematics and related subjects, Board of Studies in Mathematics with consent of teachers of Mathematics and Computer Science from different colleges affiliated to University of Pune has prepared the syllabus of **M.Sc. (Industrial Mathematics with Computer Applications).**

The course will follow the credit system of the Savitribai Phule Pune University to develop the syllabus the U.G.C. Model curriculums followed. **For successful completion of the course, 120 credits will have to be obtained.**

Aims:

i) Give the students sufficient knowledge of fundamental principles, methods and a clear perception of the innumerous power of mathematical ideas and tools and knowledge of how to use them by modeling, solving and interpreting.
ii) Reflecting the broad nature of the subject and developing mathematical tools for continuing further study in various fields of science.
iii) Enhancing students' overall development and to equip them with mathematical modeling abilities, problem solving skill, creative talent and power of communication necessary for various kinds of employment
iv) Enabling students to develop a positive attitude towards mathematics as an interesting and valuable subject of study.

Objectives:

i) A student should be able to recall basic facts about mathematics and should be able to display knowledge of conventions such annotations, terminology and recognize basic geometrical figures and graphical displays, state important facts resulting from their studies.
ii) A student should get a relational understanding of mathematical concepts and concerned structures, and should be able to follow the patterns involved with mathematical reasoning.
iii) A student should get adequate exposure to global and local concerns so as to explore many aspects of Mathematical Sciences.

iv) A Student should be able to apply their skills and knowledge, that is, translate information presented verbally into mathematical form, select and use appropriate mathematical formulae or techniques in order to process the information and draw the relevant conclusion.
v) A student should be made aware of history of mathematics and hence of its past, present and future role as part of our culture.
vi) A student should be able to write necessary algorithms and programs in different languages as per the need of the industry

Course Outcome:

1. An ability to apply knowledge of mathematics and computer science in practice
2. An ability to identify, critically analyze, formulate and solve problems with comprehensive knowledge in the area of specialization
3. An ability to contribute by research and innovation to solve real life problems
4. An ability to devise and conduct experiments, interpret data and provide well informed conclusions
5. An ability to function professionally with ethical responsibility as an individual as well as in multidisciplinary teams with positive attitude.
6. An ability to communicate effectively
7. An ability to appreciate the importance of goal setting and to recognize the need for life-long reflective learning

Structure of the course:

Semester – III

T/P/E: Theory/Practical/Elective

T/P	Code	Course Title	% of Assessment		Total Marks	Lectures/Week	No of Credits
			IA	UE			
T	MIM-301	Operational Research	30	70	100	4	4
T	MIM-302	Algebra	30	70	100	4	4
T	MIM-303	Advanced Java	30	70	100	4	4
T	MIM-304	Operating System	30	70	100	4	4
P	MIM-305	Lab Work	30	70	100	4	4
E	MIM-306	Computer Networks	30	70	100	2	2
E	MIM-307	R Programming For Basic Data Analysis	30	70	100	2	2

Note: Student can choose only one elective out of two.

Semester – IV

T/P/E: Theory/Practical/Elective

T/P	Code	Course Title	% of Assessment		Total Marks	Lectures/Week	No of Credits
			IA	UE			
T	MIM-401	Differential Equations	30	70	100	4	4
T	MIM-402	Statistical Methods	30	70	100	4	4
T	MIM-403	Design and Analysis of Algorithms	30	70	100	4	4
T	MIM-404	Internet Programming	30	70	100	4	4
T	MIM-405	Mobile Technologies	30	70	100	4	4
P	MIM-406	Lab Work	30	70	100	4	4

Proposed Structure of M. Sc.(IMCA)Course

Semester – I

T/P: Theory/Practical

T/P	Code	Course Title	Lectures/Week	No of Credits
T	MIM 101	Real Analysis	4	4
T	MIM 102	Linear Algebra and its Applications	4	4
T	MIM 103	C Programming (C++)	4	4
T	MIM 104	Database Management Systems	4	4
P	MIM 105	Lab Work	4	4

Semester – II

T/P: Theory/Practical

T/P	Code	Course Title	Lectures/Week	No of Credits
T	MIM 201	Complex Analysis	4	4
T	MIM 202	Discrete Mathematical Structures	4	4
T	MIM 203	Data Structures	4	4
T	MIM 204	Software Engineering	4	4
T	MIM 205	Java	4	4
P	MIM 206	Lab Work	4	4

Semester – III

T/P/E: Theory/Practical/Elective

T/P	Code	Course Title	Lectures/Week	No of Credits
T	MIM 301	Operational Research	4	4
T	MIM 302	Algebra	4	4
T	MIM 303	Advanced Java	4	4
T	MIM 304	Operating system	4	4
P	MIM 305	Lab Work	4	4
E	MIM 306	Computer Networks	2	2
E	MIM 307	R Programming for basic Data Analysis	2	2

Semester – IV

T/P: Theory/Practical

T/P	Code	Course Title	Lectures/Week	No of Credits
T	MIM 401	Differential Equations	4	4
T	MIM 402	Statistical Methods	4	4
T	MIM 403	Design and Analysis of Algorithms	4	4
T	MIM 405	Internet Programming	4	4
T	MIM 405	Mobile Technologies	4	4
P	MIM 406	Lab Work	4	4

Semester – V

T/P/E: Theory/Practical/Elective

T/P	Code	Course Title	Lectures/Week	No of Credits
T	MIM 501	Numerical Analysis	4	4
T	MIM 502	Computational Geometry	4	4
T	MIM 503	Data Analysis With Python	4	4
T	MIM 504	Digital Image Processing	4	4
P	MIM 505	Lab Work	4	4
E	MIM 506	Cryptography and Network Security	2	2
E	MIM 507	Internet of Things	2	2

Semester –VI

Code	Course Title	No of Credits
MIM 601	Industrial Project	20

Details of Syllabus:

Semester - I

MIM 101: Real Analysis

Unit 1. Metric Spaces and its Topology: [10 lectures]

1.1 Metric Spaces Definition and Examples, k-cells, convex sets, open closed ball, properties

1.2 Definition: Neighbourhood, limit point, isolated points, closed sets, interior points, open sets, perfect sets bounded sets, dense sets, examples and properties

1.3 Definition: Open cover, compact sets, examples and properties. Theorem of Weierstrass

1.4 Connected sets, definition of separated sets, connected sets and properties

Unit 2. Numerical Sequences and series [10 lectures]

2.1 Convergent Sequences, Definition and Examples Properties
2.2 Subsequences: Definition and properties
2.3 Cauchy Sequences: Definition, Examples and properties, Definition of complete metric space, examples, Definition of Monotonic Sequences and its properties
2.4 Upper and lower limits, Definition, examples and properties
2.5 Convergence of some special sequences
2.6 Series: Definition, examples and properties, series of non-negative terms, Cauchy's condensation test and examples
2.7 The Number e
2.8 Root and ratio tests, examples
2.9 Power series, Definition, radius of Convergence, examples and properties
2.10 Summation by parts, absolute convergence

Unit 3. Continuity: [14 lectures]

3.1 Limits of functions: Definition, examples and properties
3.2 Continuous functions, Definition, examples and properties,
3.3 Continuity and Compactness
3.3.1 Bounded Set: Definition
3.3.2 Continuous image of a compact set is compact and related properties
3.3.3 Definition of Uniform Continuity and related properties
3.4 Continuity and Connectedness: continuous image of connected set is connected and related properties
3.5 Discontinuities, Definition, examples
3.6 Monotonic functions, Definition examples and properties

Unit 4. Differentiation: [06 lectures]

4.1 Derivative of a real function, Definition examples and properties
4.2 Mean Value Theorem
4.3 Continuity of derivatives,
4.4 Taylor's theorem
4.5 Differentiation of a vector valued function

Unit 5. Riemann Stieljes Integral: [10 lectures]

5.1 Definition and existence of the integral, related properties
5.2 Properties of the integral
5.3 Integration and differentiation
5.4 Integration of vector valued functions

Unit 6. Sequences and series of function: [10 lectures]

6.1 Discussion of main problem- with examples
6.2 Uniform convergence: Definition and properties
6.3 Uniform convergence: and continuity
6.4 Uniform convergence: and integration
6.5 Uniform convergence: and differentiation

Text Book:

Walter Rudin: Principles of Real Analysis, (3rd Edition, Tata McGraw Hill Publication) Art. 2.15 to 2.42, 2.45 to 2.47, Art. 3.1 to 3.46, Art. 4.1 to 4.18 4.19 (Statement only), 4.22 to 4.28, 4.29 (Statement only), 5.1 to 5.12, 5.15 to 5.19, 6.1 to 6.15, 6.20, to 6.25, Art 7.1 to 7.17.

Reference Books:

1. C. C. Pugh, Real Mathematical Analysis.
2. T. M. Apostol, Mathematical Analysis
3. G. F. Simmons, Topology and Modern Analysis

MIM 102: Linear Algebra

Overview: To provide a basic thorough understanding of a core course in Linear Algebra techniques and theory; and to provide a sampler (aperitif) of applications to Computer Science.

Unit 1. General Vector Spaces: **[16 lectures]**

1.1 Real Vector Spaces
1.2 Subspaces
1.3 Linear Independence
1.4Basis and Dimension
1.5 Row Space, Column Space and Null Space
1.6 Rank and Nullity

Unit 2. Inner Product Spaces: **[8 lectures]**

2.1 Inner Products
2.2 Angle and Orthogonality in Inner Product Spaces
2.3 Orthonormal Bases: Gram-Schmidt Process

Unit 3. Eigenvalues, Eigenvectors: **[10 lectures]**

3.1 Eigenvalues and Eigenvectors
3.2 Diagonalization
3.3 Orthogonal Diagonalization

Unit 4. Linear Transformations: **[8 lectures]**

4.1 General Linear Transformations
4.2 Kernel and Range
4.3 Inverse Linear Transformations
4.4 Matrices of General Linear Transformations

Unit 5. Elementary Canonical Forms: **[10 lectures]**

5.1 Introduction
5.2 Characteristic Values

5.3 Annihilating Polynomials
5.4 Invariant Subspaces
5.5 Simultaneous Triangulation; Simultaneous Diagonalization

Unit 6. Applications of Linear Algebra: [8 lectures]

6.1 Geometry of Linear Operators on R2
6.2 Approximation Problems; Fourier Series
6.3 LU-Decomposition
6.4 Cryptography

Text Books:

1. **Elementary Linear Algebra (Applications Version); Howard Anton and Chris Rorres, 9th Edition, Wiley Student Edition**
   Chapter 5: Sec.5.1 to Sec.5.6
   Chapter 6: Sec. 6.1 to Sec. 6.3
   Chapter 7: Sec. 7.1 to Sec. 7.3
   Chapter 8: Sec. 8.1 to Sec. 8.4
   Chapter 9: Sec. 9.2; Sec. 9.4; Sec. 9.9
   Chapter 11: Sec. 11.16
2. **Linear Algebra; Kenneth Hoffman, Ray Kunze, 2nd Edition, PHI**
   Chapter 6: Sec. 6.1 to 6.5

Reference Books:

1. Linear Algebra and its Applications; 5th Edition, David C. Lay, Stephen R. Lay, Judi J. Mc Donald, Pearson Publications
2. Introduction to Linear Algebra; Krishnamurthy
3. Schaum's Outline of Linear Algebra; 3rd Edition

MIM 103: C Programming

Unit 1. Introduction [02 lectures]

Unit 2. Types, Operators, and Expressions [08 lectures]

2.1 Variable Names.
2.2 Data Types and Sizes.
2.3 Constants.
2.4 Declarations
2.5 Arithmetic Operators.
2.6 Relational and Logical Operators.
2.7 Type Conversions.
2.8 Increment and Decrement Operators.
2.9 Bitwise Operators.
2.10 Assignment Operators and Expressions.
2.11 Conditional Expressions.
2.12 Precedence and Order of Evaluation.

Unit 3. Control Flow **[08 lectures]**

3.1 Statements and Blocks.
3.2 If-Else.
3.3 Else-If.
3.4 Switch.
3.5 Loops- While and For.
3.6 Loops- Do-while.
3.7 Break and Continue.
3.8 Goto and Labels.

Unit 4. Functions and Program Structure **[10 lectures]**

4.1 Basics of Functions.
4.2 Functions Returning Non-integers.
4.3 External Variables.
4.4 Scope Rules.
4.5 Header Files.
4.6 Static Variables.
4.7 Register Variables.
4.8 Block Structure.
4.9 Initialization.
4.10 Recursion.
4.11 The C Preprocessor.

Unit 5. Pointers and Arrays **[12 lectures]**

5.1 Pointers and Addresses.
5.2 Pointers and Function Arguments.
5.3 Pointers and Arrays.
5.4 Address Arithmetic.
5.5 Character Pointers and Functions.
5.6 Pointer Arrays; Pointers to Pointers.
5.7 Multi-dimensional Arrays.
5.8 Initialization of Pointer Arrays.
5.9 Pointers vs. Multi-dimensional Arrays.
5.10 Command-line Arguments.
5.11 Pointers to Functions.
5.12 Complicated Declarations.

Unit 6. Structures **[10 lectures]**

6.1 Basics of Structures.
6.2 Structures and Functions.
6.3 Arrays of Structures.
6.4 Pointers to Structures.
6.5 Self-referential Structures.
6.6 Typedef.
6.7 Unions.
6.8 Bit-fields.

Unit 7. Input and Output **[10 lectures]**

7.1 Standard Input and Output.
7.2 Formated output- printf.
7.3 Variable-length Argument Lists

7.4 Formatted Input-Scanf
7.5 File Access
7.6 Error Handling-Stderr and Exit
7.7 Line Input and Output
7.8 Miscellaneous Functions

References:

1. Kernighan and Ritchie : The C Programming language.
2. Forouzan and Gilberg : Structured Programming approach using C, Thomson learning publications.
3. Herbert Schildt : Complete C Reference.

MIM 104: DBMS

Course Objectives:

1. To understand the fundamental concepts of database management. These concepts include aspects of database design, database languages, and database-system implementation
2. To provide a strong formal foundation in database concepts, technology and practice
3. To give systematic database design approaches covering modeling, conceptual design, logical design and an overview of physical design
4. Be familiar with the basic issues of transaction processing and concurrency control

Course Outcomes:

1. Design E-R Model for given requirements and convert the same into database tables.
2. Use Relational database techniques such as PgSQL& PL/SQL.

Unit 1: Introduction to DBMS [6 Lectures]

1.1 Overview
1.2 File system Vs DBMS
1.3 Describing & storing data (Data models (relational,hierarchical, network))
1.4 Levels of abstraction
1.5 Data independence
1.6 Queries in DBMS (SQL : DDL,DML,DCL,TCL)
1.7 Structure of DBMS, People who deal inDBMS
1.8 Advantages of DBMS

Unit 2: Conceptual Design (E-R model) [12 Lectures]

2.1: Overview of DB design
2.2: ER data model (entities,attributes, entity sets, relations, relationship sets)
2.3: Additional constraints (key constraints, participation constraints, weak entities, aggregation / generalization.
2.4:Conceptual design using ER (entities VS attributes, Entity Vs relationship, binary Vs ternary, constraints beyond ER)
2.5: Conceptual design for small to large enterprises,Case studies

Unit 3: Relational data model **[6 Lectures]**

3.1: Relations (concepts, definition)
3.2: Conversion of ER toRelational model , integrity constraints (key, referential integrity, general constraints)

Unit 4: Relational algebra **[8 Lectures]**

4.1: Preliminaries
4.2: Relational algebra (selection, projection,set operations, renaming, joins, division)
4.3: Advance RA operators (Aggregate operators)

Unit 5: SQL **[15 Lectures]**

5.1: DDL (create, drop, alter)
5.2:Forms of a basic SQL query (egs, expressions, strings in SQL)
5.3:Union / intersection / except, nested queries(introduction
5.4:Correlated queries
5.5:Set comparison operators)
5.6: Aggregate operators (group by, having), aggrerate functions, Null values (comparison using NULL, logical connections (AND,OR,NOT) impact on SQL commands, outer joins,disallowing NULL)
5.7: Examples on SQL (case studies)

Unit 6: Functional dependency **[8 Lectures]**

6.1: Introduction to schema refinement
6.2:Problems caused by redundancy
6.3: Use of decomposition
6.4:Problems related to decomposition
6.5:Functional dependencies
6.6: F+, attribute closure
6.7: Algorithm for identifying super keys
6.8: Normalization forms (1NF, 2NF, 3NF, BCNF),

Unit 7: PL/PgSQL **[10 Lectures]**

7.1: A PL/SQL block
7.2:Concept of a Stored Function(Creation/Updation/Deletion)
7.3: Cursors
7.4: Exception Handling
7.5: Database Triggers, Views

References:-

1. Fundamentals of Database Systems (4th Ed) By: Elmasri and Navathe
2. Database System Concepts (4th Ed) By: Korth, Sudarshan, Silberschatz
3. Practical PostgreSQL ,O'reilly Series

MIM 105: Lab Work

Assignments based on MIM 103(C programming) and MIM 104(DBMS)

Semester - II

MIM 201: Complex Analysis

Unit 1. Complex Numbers **[08 hours]**

1.1 : Sums and Products
1.2 : Basic Algebraic Properties
1.3 : Further Properties
1.4: Vectors and Moduli
1.5: Complex Conjugates
1.6: Exponential Form
1.7: Products and Powers in Exponential Form
1.8: Arguments of Products and Quotients
1.9:Roots of Complex Numbers
1.10: Examples
1.11: Regions in the Complex Plane.

Unit 2. Analytic functions **[12 hours]**

2.1 : Functions of Complex Variables
2.2 : Mappings
2.3 :Limits
2.4 :Theorems on Limits
2.5 :Limits Involving the Point at Infinity
2.6 : Continuity
2.7 : Derivatives
2.8 :Differentiation Formulas
2.9 : Cauchy- Riemann Equations
2.10 :Sufficient Conditions for Differentiability
2.11 :Polar Coordinates
2.12 :Analytic Functions
2.13 : Examples
2.14 :Harmonic Functions
2.15 :Uniquely Determined Analytic Functions.

Unit 3. Elementary Functions **[08 hours]**

3.1 : The Exponential Functions
3.2 : The Logarithmic Function
3.3 : Branches and Derivatives of Logarithms
3.4 : Some Identities Involving Logarithms
3.5 : Complex Exponents
3.6 : Trigonometric Functions
3.7 :Hyperbolic Functions
3.8 :Inverse Trigonometric and Hyperbolic Functions.

Unit 4. Integrals **[12 hours]**

4.1 : Derivatives of Functions
4.2 : Definite Integrals of Functions
4.3 : Contours
4.4 :Contour Integral
4.5 : Some Examples
4.6 :Examples with Branch Cuts

4.7 : Upper Bounds for Moduli of Contour Integrals
4.8 : Anti-Derivatives
4.9 : Proof of the Theorem
4.10 :Cauchy-Goursat's Theorem (without proof)
4.11 :Simply and Multiply Collected Domains (only definitions)
4.12 : Cauchy Integral Formula
4.13 : An Extension of Cauchy Integral Formula
4.14 : Some Consequences of the Extension(Morera Theorem)
4.15 : Derivatives of Analytic Functions
4.16 :Liouville's Theorem and Fundamental Theorem of Algebra
4.17 : Maximum Modulus Principle

Unit 5. Series **[08 hours]**
5.1 :Convergence of Sequence
5.2 :Convergence of Series
5.3 : Taylor's Series
5.4 : Proof of Taylor's Theorem
5.5 : Examples
5.6 :Laurent Series
5.7 :Proof of Laurent's theorem
5.8 : Examples

Unit 6. Residues and Poles **08 hours]**
6.1 : Isolated Singular Points
6.2 : Residues
6.3 : Cauchy Residue Theorem
6.4 : Residue at Infinity
6.5 :The three Types of Isolated Singular Points
6.6 : Residues at poles
6.7 : Zeros of Analytic Functions
6.8 : Zeros and Poles
6.9 : Behavior of Functions Near Isolated Singular Points

Unit 7. Applications of Residues **[04 hours]**
7.1 :Evaluation of Improper Integrals
7.2 :Examples

Text Book:
J.W. Brown and R.V. Churchill, Complex Variables and Applications, International Student Edition, 2009.(Eighth Edition, Tata McGraw Hill).
Chapter1 : Sec. 1 to 11.
Chapter 2: Sec.12 to 13, Sec. 15 to 27.
Chapter 3 : Sec. 29 to 36.
Chapter 4 : Sec. 37 to 46 and Sec. 48 to 54.
Chapter 5 : Sec. 55 to 62.
Chapter 6: Sec. 68 to 77.
Chapter 7: Sec. 78 to 79.

Reference Books:
1. S. Ponnusamy, Complex Analysis, Second Edition (NarosaPublishing house).
2. John B. Conway : Functions of one complex variable (Narosa Publishing house)

3. S. Lang, Complex Analysis, (Springer Verlag).
4. A.R. Shastri, An Introduction to Complex Analysis, (MacMillan).
5. Joseph Bak, Donald F. Newman, Complex Analysis (Second Edition, Springer).

MIM 202: Discrete Mathematical Structures

Unit 1: Counting Techniques [16 Lectures]

1.1 The Basics of Counting
1.2 The Pigeonhole Principle
1.3 Permutations and Combinations
1.4 Binomial Coefficients
1.5 Generalized Permutations and Combinations
1.6 Applications of Recurrence Relations
1.7 Solving Linear Recurrence Relations
1.8 Divide-and-Conquer Algorithms and Recurrence Relations

Unit 2: Graphs [16 Lectures]

2.1 Graphs and Graph Models
2.2 Graph Terminology and Special Types of Graphs
2.3 Representing Graphs and Graph Isomorphism
2.4 Connectivity
2.5 Euler and Hamilton Paths
2.6 Shortest-Path Problems
2.7 Planar Graphs
2.8 Graph Coloring

Unit 3: Trees [16 Lectures]

3.1 Introduction to Trees
3.2 Applications of Trees
3.3 Tree Traversal
3.4 Spanning Trees
3.5 Minimum Spanning Trees

Unit 4: Boolean Algebra [12 Lectures]

4.1 Boolean Functions
4.2 Representing Boolean Functions
4.3 Logic Gates
4.4 Minimization of Circuits

Text Book:

Kenneth H. Rosen, DISCRETE MATHEMATICS AND ITS APPLICATIONS, SEVENTH EDITION, Tata McGrew-Hill Publishing Company Limited, Special Indian Edition 2007 (6.1-6.5, 8.1-8.3, 10.1-10.8, 11.1-11.5, 12.1-12.4)

Reference Books:

1. NarsinghDeo, Graph Theory with Applications to Computer Science and Engineering, PHI Publication.
2. C. L. Liu, Elements of Discrete Mathematics, Tata McGraw Hill.

MIM 203: Data Structures

Course Objectives:

1. To teach the concept of fundamental data structures, for data storage and fast retrieval
2. Focus on Efficient algorithms, with respect to different storage methods
3. To Provide a solid background in algorithms, from the Computer science perspective.
4. To understand the pros and cons of various sorting and searching methods

Course Outcomes:

On completion of the course, students will be able to :

1. To discriminate on the usage of various data structures , in deriving a problem solution.
2. To design algorithms to solve programming problems
3. To use effective and appropriate data structures in solving Computer Science domain problems
4. To use appropriate algorithmic strategy for better efficiency.

Unit 1: Introduction to data structures [2 Lectures]

1.1 Concept
1.2 Data type, Data object
1.3 ADT
1.4 Need of Data Structure
1.5 Types of Data Structure

Unit 2: Algorithm analysis [6 Lectures]

2.1 Algorithm – definition, characteristics
2.2 Goal of analysis of algorithms
2.3 Running time analysis
2.4 How to compare algorithms
2.5 Rate of growth, Commonly used rates of growth
2.6 Types of analysis
2.7 Space complexity, time complexity
2.8 Asymptotic notation (Big O, Omega _)

Unit 3: Linear data structures [10 Lectures]

3.1 Introduction to Arrays - array representation
3.2 Sorting algorithms with efficiency : Comparison based(Bubble sort, Quick sort, Insertion sort , Merge sort), Non-Comparison based (Counting sort, Radix sort, Bucket sort)
3.3 Comparison of Sorting algorithms.

Unit 4: Linked List [8 Lectures]

4.1 Introduction to List
4.2 Implementation of List – static & dynamic representation
4.3 Types of Linked List : singly, Doubly, Circular
Unrolled Link lists, Skip lists
4.4 Operations on List
4.5 Applications of Linked List – polynomial manipulation
4.6 Generalized linked list – concept & representation

Unit 5: Stacks [6 Lectures]

5.1 Introduction
5.2 Representation-static & dynamic
5.3 Operations
5.4 Application - infix to postfix & prefix, postfix evaluation,
5.5 Recursion using implicit stack
5.6 Concept of Multiple stacks

Unit 6: Queues [8 Lectures]

6.1 Introduction
6.2 Representation -static & dynamic
6.3 Operations
6.4 Circuler queue, DeQue, priority queues
6.5 Concept of Multiple Queues

Unit 7: Trees [14 Lectures]

7.1 Concept & Terminologies
7.2 Binary tree, binary search tree
7.3 Representation – static & dynamic
7.4 Operations on BST – create. Insert, delete, traversals (preorder, inorder, postorder), counting leaf, non-leaf & total nodes
7.5 Threaded binary tree traversals,
7.6 XOR trees, Expression trees
7.7 Application - Heap sort
7.8 Height balance tree- AVL trees- Rotations

Unit 8: Graph [6 Lectures]

8.1 Concept & terminologies
8.2 Graph Representation
8.3 Traversals – BFS & DFS
8.4 Applications – AOV network – topological sort
8.5 AOE network – critical path
8.6 Shortest path with implementation

References:

1. Fundamentals of Data Structures ---- By Horowitz Sahani (Galgotia)
2. Data Structure and Algorithms made easy: By NarasimhaKarumanchi
3. Data Structures using C --- By ISRD Group (Tata McGraw Hill)
4. Introduction to Data Structures using C---By Ashok Kamthane
5. Data Structures using C --- Bandopadhyay&Dey (Pearson)

MIM 204: Software Engineering

Course Objectives:

1. To learn and understand the principles of Software Engineering
2. To be acquainted with methods of capturing, specifying, visualizing and analyzing software requirements.
3. To understand O-O S/W development life cycle, Using O.O.S.E principles
4. To apply a Modeling Language (UML) for modeling an Object oriented S/W system development.
5. To understand the concept of testing an O-O S/W.

Course Outcomes:

On completion of the course, student will be able to–

1. Design various models to depict the development of a object oriented software system.
2. Design test cases of a software system.

Unit 1 : Introduction to Software Engineering, Software Process models **[10 Lectures]**

1.1: Nature of Software
1.2: Software Engineering Principles
1.3: The Software Process
1.4: Software Myths.
1.5: Process Models **:**A Generic Process Model
1.6: Prescriptive Process Models: The Waterfall, Incremental Process (RAD), Evolutionary Process, Unified Process, Concurrent.
1.7: Advanced Process Models & Tools**:** Agile software development: Agile methods, Plan-driven and agile development, Extreme programming Practices, Testing in XP, Pair programming.
1.8: Introduction to agile tools: JIRA, Kanban,

Unit 2: Object Oriented Concepts and Principles **[6 Lectures]**

2.1: What is Object Orientation
2.2: Introduction to an Object, Classes and Instance
2.3: Polymorphism
2.4: Inheritance
2.5: Object Oriented System Development
2.5.1: Introduction
2.5.2: Function/Data Methods (With Visibility)
2.5.3: Object Oriented Analysis
2.5.4: Object Oriented Construction
Identifying the Elements of an Object Model,

Identifying Classes and Objects, Specifying the Attributes (With Visibility) , Defining Operations Finalizing the Object Definition

Unit 3: Introduction to UML **[2 Lectures]**

3.1: Concept of UML
3.2: Advantages of UML

Unit 4: **Basic Structural Modelling** **[5 Lectures]**

4.1: Classes
4.2: Relationships
4.3: Common Mechanisms
4.4: Class Diagram

Unit 5: Advanced Structural Modelling **[7 Lectures]**

5.1: Advanced Classes
5.2: Advanced Relationship
5.3: Interface, Types and Roles
5.4: Packages
5.5: Object Diagrams

Unit 6 : Basic Behavioral Modelling **[9 Lectures]**

6.1: Interactions
6.2: Use Cases and Use Case Diagram with stereo types
6.3: Interaction Diagram
6.4: Sequence Diagram
6.5: Activity Diagram
6.6: State Chart Diagram

Unit 7: Object Oriented Analysis **[6 Lectures]**

7.1: Iterative Development and the Rational Unified Process
7.2: Inception
7.3: Understanding Requirements
7.4: Use Case Model From Inception to Elaboration
7.5: Elaboration

Unit 8: Object Oriented Design **[4 Lectures]**

8.1: The Generic Components of the OO Design Model
8.2: The System Design Process
8.2.1: Partitioning the Analysis Model
8.2.2: Concurrency and Sub System Allocation
8.2.3: Task Management Component

8.2.4: The Data Management Component
8.2.5: The Resource Management Component
8.2.6: Inter Sub System Communication
8.3: Object Design Process

Unit 9: Architectural Modelling [6 Lectures]

9.1:Component
9.2: Components Diagram
9.3: Artifacts of the system &Artifact diagram
9.4 : Deployment Diagram
9.5: Collaboration Diagram

Unit 10 : Object Oriented Testing [5 Lectures]

10.1: Object Oriented Testing Strategies
10.2: Test Case Design for Object Oriented Software
10.3: Inter Class Test Case Design

References:

1. Roger Pressman, ―Software Engineering: A Practitioner‘s Approach‖, McGraw Hill, ISBN 0–07–337597–7
2. Ian Sommerville, ― Software Engineering‖, Addison and Wesley, ISBN 0-13-703515-
3. Grady Booch, James Rambaugh,"The Unified Modeling Language User/Reference Guide",Pearson Education INC
4. Ivar Jacobson, "Object Oriented Software Engineering", Pearson Education INC
5. Craig Larman, "Applying UML and Patterns", Pearson Education INC
6. Bennett, Simon," Object Oriented Analysis and Design" McGraw Hill

MIM 205 JAVA

Unit 1. Introduction to Object Oriented Concepts [05 lectures]

1.1. Object, Class
1.2. Encapsulation, Abstraction, Data Hiding, Inheritance, Polymorphism
1.3. Message Passing, Dynamic binding
1.4. History of Object Oriented languages
1.5. Comparison with structured programming

Unit 2. Introduction to The Java Technology [04 lectures]

2.1. The Java platform, Java buzzwords, API, JVM
2.2. Java compiler, bytecodes
2.3. java editions

Unit 3. Main features of Java language 06 lectures]

3.1. Introduction to Java, Writing & compiling Java programs- the main method
3.2. Command line arguments, String class, Primitive data types, Variables and assignment, javadoc comments
3.3. Expressions, Data conversion, Interactive programs, Boolean data type

and expressions { If, Switch } statements, { For, While, Do } statements, Creating, callingmethods, Parameter passing, Returning values, Overloading methods,
Scope of variables.

Unit 4. Arrays **[05 lectures]**

4.1. Defining and initializing arrays, new operator, using arrays
4.2. passing arrays to methods, returning arrays from methods
4.3. command-line arguments
4.4. 2-dimensional arrays

Unit 5. Objects and Classes **[05 lectures]**

5.1. Defining Class, Creating object, reference variables
5.2. Visibility modifiers – public, private, protected
5.3. Object members and class members (static), Arrays of objects, this keyword, Wrapper Classes

Unit 6. Packages and Interfaces **[05 lectures]**

6.1. Concept of package, Package and import keywords
6.2. Concept of interfaces, Implementing interfaces
6.3. Use of predefined packages
6.4. Use of predefined interfaces – Comparable and Comparator

Unit 7. Inheritance and Polymorphism **[05 lectures]**

7.1. Superclass and Subclass – extends keyword, super keyword, Overriding members
7.2. Protected data members- Object Class and its toString() method,AbstractClasses
7.3. Final classes, methods and variables, instance of operator
7.4. dynamic binding , Casting objects

Unit 8. Exceptions and Exception handling **[05 lectures]**

8.1. Exception class hierarchy
8.2. Checked and unchecked exceptions
8.3. Try, catch, throw, throws finally keywords
8.4. Creating user defined exceptions

Unit 9. Text and File I/O **[05 lectures]**

9.1. Predefined I/O classes
9.2. Simple I/O operations using console and files
9.3. The File class

Unit 10. GUI and Event Handling using Java **[05 lectures]**

10.1. Introduction to AWT and Swing
10.2. Creating containers and components (JFrame, JPanel, JButton, JTextField, JCheckBox, JRadioButton, JMenu, JList, JTable)
10.3. Layout Managers
10.4. Delegation event model - Event sources, event listeners, event classes.

Unit 11. JDBC **[05 lectures]**

11.1. The Design of JDBC
11.2. The Structured query language
11.3. Basic JDBC programming concepts

11.4. Query Execution
11.5. Scrollable and updatable result sets.

Unit 12. Introduction to collections [05 lectures]
12.1. Concrete Collections
12.1.1. Linked List
12.1.2. Array Lists
12.1.3. Hash Sets
12.1.4. Tree Sets
12.1.5. Maps

Reference Books:
1. Java : How to Program, Deitel and Deitel, Prentice Hall
2. Core Java 2: Volume I – Fundamentals, Cay S. Horstmann and Gary Cornell; Prentice-Hall 2002. ISBN 0130471771
3. Core Java 2: Volume II – Advanced Features, Cay S. Horstmann and Gary Cornell; Prentice-Hall 2001. ISBN 0130927384
4. Java: The Complete Reference, Herbert Schildt. Fifth Edition
5. Introduction to Java Programming, Daniel Liang
Important URLs :http://java.sun.com/reference/docs/

MIM – 206

Lab Work on MIM 203(Data Structures) and MIM 205(Java Programming)

Semester - III

MIM 301: Operational Research

Unit 1. Modeling with Linear Programming [06 Lecture]
1.1 Two variable LP model
1.2 Graphical LP solutions
1.3 Selected LP applications.

Unit 2. Simplex method and Sensitivity Analysis [12 Lecture]
2.1 LP model in equation form
2.2 Transition from graphical to algebraic solution
2.3 Simplex method
2.4 Artificial Starting Solution
2.5 Special Cases in the Simplex Method
2.6 Sensitivity Analysis

Unit 3. Duality and Post-Optimal Analysis [08 Lecture]
3.1 Definition of the Dual Problem
3.2 Primal-Dual Relationships
3.3 Economic Interpretation of Duality
3.4 Additional Simplex Algorithms
3.5 Post-Optimal Analysis

Unit 4. Transportation Model and Its Variants **[08 Lecture]**

4.1 Definition of the Transportation Model
4.2 Nontraditional Transportation Models
4.3 The Transportation Algorithm
4.4 The Assignment Model

Unit 5. Network Models **[10 Lecture]**

5.1 Scope and Definition of Network Models
5.2 Minimal Spanning Tree Algorithm
5.3 Shortest-Route Problem
5.4 Maximal flow model
5.5 CPM and PERT

Unit 6. Advanced Linear Programming **[08 Lecture]**

6.1 Simplex Method Fundamentals
6.2 Revised Simplex Method
6.3 Bounded-Variables Algorithm
6.4 Duality

Unit 7. Integer Linear Programming **[08 Lecture]**

7.1 Illustrative Applications
7.2 Integer Programming Algorithms

NB : Use suitable mathematical software to solve relevant problems.

Reference Book(s):

• Hamy A.Taha, Operations Research, (Eighth Edition, Prentice Hall of India), 2008.
• J. K. Sharma, Operations Research, (Third Edition, Macmillan India Ltd.), 2008.
• P. K. Gupta and D. S. Haria, Operations Research, (Fifth Edition, S. Chand), 2014.

MIM 302: Algebra

Unit 1 **(10 Lectures)**

1.1 Introduction to Groups
1.2 Symmetries of a square
1.3 Dihedral Groups
1.4 Examples and properties of Groups
1.5 Finite Groups
1.6 Subgroups Cyclic Groups.

Unit 2 **(18 Lectures)**

2.1 Permutation Groups and its properties
2.2 Isomorphisms
2.3 Cayley's Theorems
2.4 Cosets and Langrange's Theorem

2.5 External Direct Products(Theorems without proof), Normal subgroups and Factor Groups and Applications.

Unit 3 **(14 Lectures)**

3.1 Group Homomorphisms
3.2 First Isomorphism Theorem
3.3 Fundamental Theorem of Finite Abelian Groups.
3.4 Sylow Theorems(without proof): only statements and problems

Unit 4 **(18 Lectures)**

4.1 Introduction to Rings
4.2 Integral Domains, Fields
4.3 Ideals
4.4 Ring Homomorphisms
4.5 Polynomial Rings
4.6 Factorization of Polynomials
4.7 Divisibility in Integral Domains.

OPTIONAL Topics suggested for internal evaluation (seminar/project/essays etc)

1) A check-digit scheme based on D5,
2) Applications of Cosets and Permutation Groups,
3) Rotation Group of a cube and Soccer.
4) Applications of External Direct Product

Text Books :

Joseph Gallian – Contemporary Abstract Algebra (Narosa Publishing House).
Joseph Gallian –Contemporary Abstract Algebra EIGHTH EDITION(soft copy)
Chapters :- 2 to18 and 24 (for all chapters as per above mentioned topics)

Reference Books :-

1. I.N. Herstein : Topics in Algebra (Wiley - Eastern Ltd)
2. Fraleigh : A First Course in Abstract Algebra
3. M. Artin : Algebra (Prentice Hall)
4. N.S. Gopalkrishna : University Algebra.(Wiley - Eastern Ltd)

MIM 303: Advanced Java

Unit 1 **Graphic programming Using Swing** **[4Lectures]**

1.1. Working with 2D Basic Shapes
1.2. Using Color
1.3. Using Font
1.4. Displaying Images

Unit 2 **Multithreading** **[7Lectures]**

2.1 What Are Threads
2.2 Running and Starting Thread
2.3 Running Multiple Threads
2.4 The Run able Interface
2.5 Thread Priorities
2.6 Synchronization and inter Thread Communication

Unit 3 **Database Programming** **[8Lectures]**

3.1 JDBC Design And Configuration Details
3.2 Types of Drivers
3.3 Query Building And Execution
3.4 Result sets, Row Sets
(Implementation of Case study)

Unit 4 **Collections** **[8Lectures]**

4.1 Introduction to Collection Framework
(interfaces, implementation and algorithms),Interfaces,
4.2 Collection Classes: Set,List, Queue and Map
4.3 Set:HashSet,TreeSet,Linked HashSet
4.4 Interfaces Such as Lists,set,vectors,linked
List,Comparator
4.5 Iterator,Hash Tables

Unit 5 **Servlet** **[10Lectures]**

5.1 Introduction To Servlet(HTTP servlet)
5.2 Life cycle of Servlet
5.3 Handling GET and POIST request(HTTP)
5.4 Data Handling using Servlet
5.5 Creating CookIes
5.6 Session tracking

Unit 6 **JSP** **[7Lectures]**

6.1 Getting Familier with JSP Server
First JSP
6.2 Adding Dynamic Contents via Expressions
6.3 Scriptlets,Mixing Scriptlets and HTML
6.4 Directives, Declaration, Tag and session

Unit 7 Networking **[7Lectures]**

7.1The JAVA.NET package
7.2 Connection Oriented Transmission- Stream Socket class
7.3 Creating a socket to a remote post on a port
7.4 Simple socket program , Examples

Unit 8 JAVA Bean Components **[4Lectures]**

8.1 Why Beans
8.2 The Bean Writing Process
8.3 Using Bean To Build An Application

Unit 9 Introduction to JAVA Frameworks **[5Lectures]**

9.1 Java Frameworks
9.2 What is frame work?
9.3 Framework vs. Library vs. API
9.4 Types of Java Frameworks
9.5 Popular Java Frameworks
(Spring ,Grails ,Play,Struts,Java Server Faces (JSF),Google Web Toolkit (GWT))
9.6 Overview of Spring Framework
9.7 Advantages of Spring Framework.
9.8 Architecture of Spring Framework

Reference Book:

Complete Reference in JAVA

MIM 304: Operating System

1 Introduction to Operating System **[7 Lectures]**

1.1. What operating system can Do
  1.1.1. user view
  1.1.2. system view
  1.1.3. defining operating systems
1.2. Computer- System organization
  1.2.1. Computer System operation
  1.2.2. Storage structure
  1.2.3. I/O structure
1.3. Computer-system architecture
  1.3.1. Single-processor systems
  1.3.2. Multiprocessor systems
  1.3.3. Clustered systems
1.4. Operating system structure
1.5. Operating system operations
  1.5.1. Dual Mode operation
  1.5.2. Timer
1.6. Process management
1.7. Memory management
1.8. Storage management

1.8.1. File System management
1.8.2. Mass-storage management
1.8.3. Caching
1.8.4. I/O subsystems
1.9. Protection and security

1.10 Distributed system

2. System structure [9 Lectures]

2.1. Operating system services
2.2. User operating system Interface
2.2.1. Command Interpreter
2.2.2. Graphical user interface
2.3. System calls
2.4. Types of system calls
2.4.1. Process control
2.4.2. File management
2.4.3. Device management
2.4.4. Information maintenance
2.4.5. Communication
2.4.6. protection
2.5. System programs
2.6. System Boot Process Management
2.7. Process Concept
2.7.1. The process
2.7.2. Process State
2.7.3. Process control block
2.7.4. threads
2.8. Process Scheduling
2.8.1. Scheduling queues
2.8.2. Schedulers
2.8.3. Context switch
2.9. Operations on Processes
2.9.1. Process creation
2.9.2. Process termination

3. Process Scheduling [7 Lectures]

3.1. Basic Concepts
3.1.1. CPU- I/O Burst Cycle
3.1.2. CPU Scheduler
3.1.3. Preemptive and Non-preemptive scheduling
3.1.4. Dispatcher
3.2. Scheduling criteria (terminologies used in scheduling): CPU Utilization, Throughput, Turnaround time, Waiting time, Response time
3.3. Scheduling Algorithms – FCFS, SJF (Preemptive & non-preemptive),Priority Scheduling (Preemptive & non-preemptive), round robin scheduling with examples
3.4. Multilevel Queues, Multilevel Feedback queues

4. Process Synchronization [7 Lectures]

4.1. Background
4.2. The critical section problem
4.3. Semaphores

4.3.1. Usage
4.3.2. Implementation
4.3.3. Deadlock and starvation
4.3.4. Priority Inversion
4.4. Classic Problems of Synchronization
4.4.1. The bounded buffer problem
4.4.2. The readers –writers problem
4.4.3. The dinning philosophers problem

5. Deadlocks **[7 Lectures]**

5.1. System Model
5.2. Deadlock characterization
5.2.1. Necessary conditions
5.2.2. Resource allocation graph
5.3. Methods for handling deadlocks
5.4. Deadlock prevention
5.4.1. Mutual exclusion
5.4.2. Hold and wait
5.4.3. No preemption
5.4.4. Circular wait
5.5. Deadlock avoidance
5.5.1. Safe state
5.5.2. Resource allocation graph algorithm
5.5.3. Banker's algorithm
5.5.3.1. Safety algorithm
5.5.3.2. Resource request algorithm
5.5.3.3. Examples
5.6. Deadlock detection
5.6.1. Single instance of each resource type
5.6.2. Several instances of a resource type
5.6.3. Detection algorithm usage
5.7. Recovery from deadlock
5.7.1. Process Termination
5.7.2. Resource preemption

6. Memory management **[7 Lectures]**

6.1. Background
6.1.1. Basic Hardware
6.1.2. Address Binding
6.1.3. Logical versus physical address space
6.1.4. Dynamic loading
6.1.5. Dynamic linking and shared libraries
6.2. Swapping
6.3. Contiguous memory allocation
6.3.1. memory mapping and protection
6.3.2. memory allocation
6.3.3. fragmentation
6.4. paging
6.4.1. Basic method
6.4.2. Hardware support
6.4.3. Protection

- 6.4.4. Shared pages
- 6.5. Segmentation
  - 6.5.1. Basic Method
  - 6.5.2. hardware
- 6.6. virtual memory management –background
- 6.7. demand paging
  - 6.7.1. Basic Concepts
  - 6.7.2. Performance of demand paging
  - 6.7.3. Page replacement – with examples
    - 6.7.3.1. Basic page replacement
    - 6.7.3.2. FIFO
    - 6.7.3.3. Optimal
    - 6.7.3.4. LRU – using counter and stack
    - 6.7.3.5. Second chance
    - 6.7.3.6. LFU
    - 6.7.3.7. MFU

7. File systems [9 Lectures]

- 7.1. File concept
  - 7.1.1. File attributes
  - 7.1.2. File operations
  - 7.1.3. File types
  - 7.1.4. File structure
  - 7.1.5. Internal file structure
- 7.2. Access Methods
  - 7.2.1. Sequential Access
  - 7.2.2. Direct Access
  - 7.2.3. Other Access Methods
- 7.3. Directory and Disk Structure
  - 7.3.1. Storage Structure
  - 7.3.2. Directory Overview
  - 7.3.3. Single-level directory
  - 7.3.4. Two-level directory
  - 7.3.5. Tree structured directories
  - 7.3.6. Acyclic graph directories
  - 7.3.7. General graph directory
- 7.4. File system mounting File system sharing
  - 7.4.1. Multiple Users
  - 7.4.2. Remote file systems
    - 7.4.2.1. The client-server model
    - 7.4.2.2. Distributed Information systems
    - 7.4.2.3. Failure modes
- 7.5. Protection
  - 7.5.1. Types of access
  - 7.5.2. Access control
- 7.6. Allocation methods
  - 7.6.1. Contiguous
  - 7.6.2. Linked
  - 7.6.3. Indexed
- 7.7. Free space management
  - 7.7.1. Bit Vector

7.7.2. Linked List
7.7.3. Grouping
7.7.4. Counting

8. Disk Scheduling and I/O systems [7 Lectures]

8.1. Concept
8.2. Disk Scheduling algorithms – with examples
8.2.1. First Come First Served FCFS
8.2.2. Shortest seek time first (SSTF)
8.2.3. Scan
8.2.4. C-scan
8.2.5. Look

8.3 Kernel I/O subsystems

8.3.1 I/O Scheduling
8.3.2 Buffering
8.3.3 Caching
8.3.4 Spooling and device reservation
8.3.5 Error handling
8.3.6 I/O protection
8.3.7 Kernel data structure

Reference Books :

1. Operating System Concepts – Silberschatz, Galvin, Gagne
2. Modern Operating system by Tanenbaum , PHI Publication
3. Operating Systems : Principles and Design – Pabitra Pal Choudhary (PHI Learning Private Limited)

MIM 305: Lab Work

Lab Work on MIM 303(Advanced Java) and MIM 304(Operating System)

MIM 306: Computer Networks

Unit 1 .Network Models [4Lectures]

1.1 Reference Models
1.2 OSI and TCP/IP models and its Comparison

Unit 2. Physical Layer [5Lectures]

2.1 Tasks Performed
2.2 Data And Signals(analog and digital signals)
2.3 Transmission impairment
2.4 Data rate limits
2.5 Digital Transmission
2.6 Transmission Modes
2.7 Transmission Media

Unit 3. Data Link Layer **[5Lectures]**
3.1 DLL Design Issues
3.2 Error Detection and Correction
3.3 Elementary data link protocols
3.4 Sliding Window Protocols

Unit 4. Medium Access Layer **[5Lectures]**
4.1 Channel Allocation Problem
4.2 Multiple Access
4.3 Wired LANs Wireless LANs

Unit 5. Network Layer **[6Lectures]**
5.1 Network Layer Design Issues
5.2 Routing Algorithms
5.3 Network Layer Protocols
5.4 Address Mapping and Congestion Control

Unit 6. Transport Layer **[4Lectures]**
6.1 Transport Layer Services
6.2 Elements of Transport Protocol
6.3 Internet Transport Protocols

References:

1	**Computer Networks:**	**AS Tannumbaum 4th edition**
2	**Data Communication and Networking**	**Behrouz Forouzan 4th edition**

MIM 307: R Programming For Basic Data Analysis

Unit 1.Fundamentals of R language **[4 Lectures]**
1.1 Introduction To R
1.2 About R, Do and Don't
1.3 Why R programming Language?

[5 Lectures]
Unit 2 Overview of R Language
2.1 General Properties
2.2 First Program-Hello World
2.3 Core Characteristics
2.4 Data Types
2.5 Variables
2.6 Operators(Arithmetic, Relational, Logical Etc)

Unit 3 Decision Making and Looping in R **[5 Lectures]**
3.1 If stmt
3.2 If-else
3.3 Nested If else
3.4 For Loop
3.5 While Loop
3.6 Repeat Loop

Unit 4 Arrays and Function in R **[5 Lectures]**
4.1 Array Introduction Of R
4.2 Functions in R
4.3 Your first function and
4.4 Built in Functions

Unit 5 Objects in R Language **[6 Lectures]**
5.1 String
5.2 Vector
5.3 List
5.4 Matrix

Unit 6 Packages in R **[5 Lectures]**
6.1 Introduction to Packages
6.2 Data reshaping
6.3 Data and File Management

Reference:

R for Data Science : Hadley Wickham and Garrett Grolemund : O'Reilly Publications

Semester - IV

MIM 401: Differential Equations

Unit 1: Prerequisites **[4 Lectures]**
1.1 Linear equations of the first order

Unit 2: Linear equations with constant coefficients **[12 Lectures]**
2.1 Second order homogeneous equations
2.2 Initial value problems
2.3 Linear dependence and independence
2.4 Nonhomogeneous equations of n-th order
2.5 Algebra of constant coefficients.

Unit 3: Linear equations with variable coefficients **[12 Lectures]**
3.1 Initial value problems
3.2 Solutions of the homogeneous equation
3.3 Wronskian and linear independence
3.4 Reduction of order, Nonhomogeneous equations
3.5 Legendre equation.

Unit 4: Linear Equations with regular singular points **[12 Lectures]**
4.1 Euler equation
4.2 Second order equation with regular singular points
4.3 Exceptional cases
4.4 Bessel equation.

Unit 5: Existence and uniqueness of solutions to first order equations **[12 Lectures]**
5.1 Equations with variables separated, exact equations
5.2 Method of successive approximations

5.3 Lipschitz condition
5.4 Convergence of the successive approximations to non-local existence of solution approximations to, and uniqueness of, solutions.

Unit 6: Existence and uniqueness of solutions to systems and n-th order equations **[8 Lectures]**

6.1 Complex n-dimensional space, Systems as vector equations
6.2 Existence and uniqueness of solutions to systems
6.3 Existence, Uniqueness for linear systems and equations of order n.

Reference Books:

- E. A. Coddington, An Introduction to Ordinary Differential Equations (Prentice-Hall).
- G. F. Simmons and S. G. Krantz, Differential Equations (Tata McGraw-Hill).

MIM 402: Statistical Methods

Unit 1 Theory of Probability **[5 Lectures]**

1.1 Sample Space, Events, Types of event
1.2 Probability of an event(Definition and Examples)
1.3 Conditional Probability and Independence (Definition and Examples)

Unit 2 Random Variables **[5 Lectures]**

2.1 Random Variable (Discrete and Continuous Random variable)
2.2 Probability Distribution of Discrete and Continuous Random Variable
2.3 Distribution Function
2.4 Mean and Variance (with Properties)

Unit 3 Standard Probability Distributions **[12 Lectures]**

3.1 Binomial (n, p)
3.2 Poisson (λ)
3.3 Exponential (θ)
3.4 Uniform (a, b)
3.5 Normal (μ, $\sigma 2$)

Unit 4 Correlation and Regression Analysis **[6 Lectures]**

4.1 Product Moment Correlation Coefficient
4.2 Linear Regression
4.3 Properties of Linear Regression

Unit 5 Testing of Hypothesis **[12 Lectures]**

5.1 Large Sample Test: One sample test for mean, One sample test for proportion, Two sample test for mean, Two sample test for proportion
5.2 Small Sample Test: One sample test for mean, Two sample test for mean, Paired t-test, χ^2 test for Independence of attributes, χ^2 test for goodness of fit, One sample test for variance, One sample test for variance

Unit 6 ANOVA **[5 Lectures]**

5.1 One way ANOVA

5.2 Two way ANOVA

Unit 7 Statistical Assignments using R Software [15 Lectures]

7.1 Creating a data frame for the given data
7.2 Computation of basic statistical measures for raw data and grouped data
7.3 Fitting of Binomial, Normal and Poisson distribution
7.4 Computation of correlation coefficient and lines of regression for a bivariate data
7.5 Computation of multiple and partial correlation coefficients and fitting of multiple regression plane
7.6 Tests based on t distribution, χ^2 distribution

Reference Books:

1) Probability and Statistics for Engineers and Scientists: Walpole, Myers, Myers Ye
2) Statistics: Murray R. Spiegel, Larry J. Stephens
3) Probability and Statistics for Engineers: Richard A. Johnson, C.B.Gupta
4) Statistics using R : Narosa Publishing house by Dr. S. G. Purohit, Dr. S. D. Gore, Dr. S. R. Deshmukh

MIM 403: Designs and Analysis of Algorithms

Unit 1. Introduction [10 Lectures]

1.1 What is an Algorithm?
1.2 Algorithm Specification
1.3 Performance Analysis

Unit 2. Divide and Conquer [18 Lectures]

2.1 General Method
2.2 Binary Search
2.3 Finding the Maximum and Minimum
2.4 Merge Sort
2.5 Quick Sort- Performance Measurement
2.6 Strassen's Matrix Multiplication
2.7 Convex Hull- Some Geometric Primitives, the QuickHull Algorithm, Graham's Scan.

Unit 3. The Greedy Method [18 Lectures]

3.1 The General Method
3.2 Knapsack Problem
3.3 Tree Vertex Splitting
3.4 Job Sequencing with Deadlines- Prim's Algorithm, Kruskal's Algorithm.
3.5 Optimal Storage of Tapes
3.6 Optimal Merge Patterns
3.7 Single-Source Shortest Paths

Unit 4: Dynamic Programming [14 Lectures]

4.1 The General Method
4.2 String Editing
4.3 0/1-Knapsack
4.5 Matrix Chain Multiplication Problem.

Text Books:

1. Computer Algorithms, E. Horowitz, S. Sahni, S. Rajasekaran, Computer Science Press, (1998).
   (1.1, 1.2, 1.3, 3.1, 3.2, 3.3, 3.4, 3.5.1, 3.7, 3.8.1, 3.8.2, 3.8.3, 4.1, 4.2, 4.3, 4.4, 4.5.1, 4.5.2, 4.6, 4.7, 4.8, 5.1, 5.6, 5.7)
2. Introduction to Algorithms, T. H. Cormen, C.E. Leiserson, R.L. Revest, C. Stein, Prentice-Hall of India Private Limited; Indian Edition (2nd Edition) edition (2003).
   (15.2 Matrix Chain Multiplication Problem)

Reference Book:

Algorithm Design. Jon Kleinberg and Eva Tardos. Addison Wesley, 2005.

MIM 404: Internet Programming

Unit 1.Introduction to Web Techniques **[6 Lectures]**

1.1 HTTP Basics, Introduction to Web server and Web Browser
1.2 Introduction to PHP
1.3 What does PHP do?
1.4 Lexical Structure
1.5 Language basics

Unit 2.Function and String **[13 Lectures]**

2.1 Defining and Calling a Function
2.2 Default Parameters
2.3 Variable Parameters, Missing Parameters
2.4 Variable Function, Anonymous Function
2.5 Types of Strings in PHP
2.6 Printing Functions
2.7 Encoding and Escaping
2.8 Comparing Strings
2.9 Manipulating and Searching Strings
2.10Regular Expressions

Unit 3 Arrays **[9 Lectures]**

3.1 Indexed Vs Associative Arrays
3.2 Identifying Elements of an Array
3.3 Storing Data in Arrays
3.4 Multidimensional Arrays
3.5 Extracting Multiple Values
3.6 Converting between arrays and variables
3.7 Traversing arrays
3.8 Sorting
3.9 Action on entire Arrays
3.10 Using arrays

Unit 4 Introduction to Object Oriented Programming **[5 Lectures]**

4.1 Classes
4.2 Objects
4.3 Introspection
4.4Serialization

4.5 Inheritance
4.6 Interfaces
4.7 Encapsulation

Unit 5 Files and Directories **[8 Lectures]**

5.1 Working with Files and Directories
5.2 Opening and closing, getting information about File, read or write to File
5.3 Splitting name and path from File
5.4 Rename and delete Files
5.5 Reading and Writing Characters in File
5.6 Reading entire File
5.7 Random Access to File data
5.8 Getting information on File
5.9 Ownership and permission

Unit 6 Web Techniques **[6 Lectures]**

6.1 Variables
6.2 Server Information
6.3 Processing Forms
6.4 Setting Response Headers
6.5 Maintaining State
6.6 SSL

Unit 7 Databases **[4 Lectures]**

7.1 Using PHP to Access a Database
7.2 Relational database and SQL

Unit 8 XML **[9 Lectures]**

8.1 What is XML?
8.2 XML document Structure
8.3 PHP and XML
8.4 XML Parser
8.5 The document object model
8.6 The simple XML extension
8.7 Changing a value with simple XML

References:

1	**Programming in PHP**	**O'reilly Publication**
2	**Beginning PHP 5**	**Wrox Publication**
3	**PHP Web Services**	**Wrox Publication**
4	**PHP Cook Book**	**O'reilly Publication**
5	**PHP for Brgineers**	**Ivan Bayross**

MIM 405: Mobile Technologies

Unit 1. Introduction to Mobile Computing **[5Lectures]**

1.1 Introduction and need for Mobile computing
1.2 Mobility and portability
1.3 Mobile and Wireless devices
1.4 Mobile Applications
1.5 Mobile Operating system – IOS, BlackBery, Windows phone, Plam OS, Symbian OS,PhoneGap

Unit 2.Android Fundamentals **[9Lectures]**

2.1 Introduction to Android - Overview and evolution of Android , Features of Android, Android architecture
2.2 Components of an Android Application, Manifest file
2.3 Android Activity
2.4 Service Lifecycle

Unit 3.Android UI Design **[7Lectures]**

3.1 Basic UI Designing (Form widgets ,Text Fields , Layouts ,[dip, dp, sip, sp] versus px)
3.2 Intent(in detail)
3.3 All components (e.g Button , Slider, Image view, Toast) Event Handling
3.4 Adapters and Widgets
3.5 Menu

Unit 4.Android Thread and Notification **[9Lectures]**

4.1 Threads running on UI thread (runOnUiThread)
4.2 Worker thread
4.3 Handlers & Runnable
4.4 AsynTask (in detail)
4.5 Broadcast Receivers
4.6 Services and notifications
4.7 Toast
4.8 Alarms

Unit 5.Advanced Android Programming **[8Lectures]**

5.1 Content Providers – SQLite Programming
5.2 JSON Parsing
5.3 Accessing Phone Service(Call, SMS, MMS)
5.4 Location based services

Unit 6.PhoneGap Programming **[12Lectures]**

6.1 Why Use PhoneGap?
6.2 How PhoneGap Works
6.3 Designing for the Container
6.4 Writing PhoneGap Applications
6.5 Building PhoneGap Applications
6.6 PhoneGap Limitations
6.7 PhoneGap Plug-Ins
6.8 Hello, World! Program
6.9 PhoneGap APIs –1

6.10Accelerometer:
6.10.1 Querying Device Orientation,
6.10.2 Watching a Device's Orientation,
6.10.3 Creating a Contact, Searching for Contacts, Cloning Contacts, Removing Contacts.

Unit 7. IOS Fundamentals **[10 Lectures]**

7.1 Introduction - What is IOS ,IOS Architecture, Frameworks, Application Life Cycle, Features
7.2 Swift - Introduction to Swift ,General Concepts of Swift
7.3 Xcode - Introduction to Xcode , Navigator, Editor Utility, Tools, Console, Document, Simulator, Instruments
7.4 Startup - Application Templates, Introduction to Storyboard , Hello World Application, How 'Hello World' Working, Debugging Database, Plist, Preference, Sqlite Web Service, Restful Web Service (JSON & XML)

References:

1	A Course in Machine Learning	Hal Daumé III
2	IOS Apprentice	Matthijs Hollemans
3	PhoneGap: Beginner's Guide	Giorgio Natili, Purusothaman Ramanujam
4	Beginning Android Application Development	Wei-Meng Lee Wiley

MIM 406: Lab Work

Lab work based on MIM 404(Internet Programming) and MIM 405 (Mobile Technologies)