Department of Mathematics
Faculty of Natural Science, Jamia Millia Islamia, New Delhi-25

Course Structure of M.Sc. Mathematics with Computer Science

Semester – I

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	MTM-1.1	Real Analysis	4	4	25	75	100
2	MTM-1.2	Abstract Algebra	4	4	25	75	100
3	MTM-1.3C_1	Discrete Mathematical Structures	4	4	25	75	100
	MTM-1.3C_2	Computer Organization and Architecture	4				
4	MTM-1.4	Computer Fundamentals & C Programming	4	4	25	75	100
5	MTM-1.5	Numerical Analysis	4	4	25	75	100
	Lab-I	*Programming in C*	-	2	25	25	50

Semester – II

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	MTM-2.1	Topology	4	4	25	75	100
2	MTM-2.2	Linear Algebra	4	4	25	75	100
3	MTM-2.3	Differential Equations and Applications	4	4	25	75	100
4	MTM-2.4C_1	Data Structures in C	4	4	25	75	100
	MTM-2.4C_2	Data Structures in Java	4				
5	MTM-2.5SE	Object Oriented Programming-Java (Skill Enhancement)	4	3+1	25	75	100
6	*Lab-II*	*Data Structures using C/Java*	-	2	25	25	50

***CBCS papers subject to the availability of the teacher**

M.Sc. Mathematics with Computer Science, Semester – I

MTM-1.1	Real Analysis	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Outer and inner Lebesgue measure, Lebesgue measurable sets, Properties of measurable sets, Borel sets and their measurability, Non-measurable sets, Cantor's ternary sets and their properties.

Unit-II Measurable function, Characteristic function, Step function, Continuous function, Set of measure zero, Borel measurable function, The structure of measurable function.

Unit-III Riemann integral and its deficiency, Lebesgue integral of bounded function, Comparison of Riemann and Lebesgue integrals, Properties of Lebesgue integral for bounded measurable function, The Lebesgue integral for unbounded functions, Integral of non-negative measurable functions, General Lebesgue integral, Improper integral.

Unit-IV Point wise convergence, Convergence almost everywhere, Uniform convergence almost everywhere, Convergence in measure, F. Reisz's theorem on convergence a.e., D.F. Egoroff's theorem, Lebesgue bounded convergence theorem, Lebesgue dominated convergence theorem, Fatou's lemma, Monotone convergence theorem.

L^P-space, Properties of L^P-space, Holder's inequality, Minkowski's inequality and Schwartz's inequality, Convergence in the mean, Riesz-Fischer theorem.

Books Recommended

1. Royden, H.L., Real Analysis (2nd ed.) The Macmillan Co., new York (1968)
2. Jain, P.K. & Gupta V.P., Lebesgue measure and Integration Willey Eastern Ltd., New Age Int. Ltd., New Delhi, (1994)
3. Inder K. Rana, An Introduction to measure and integration, Narosa Publishing House, Delhi, (1997)
4. D. Somasundaran, A Second Course in Mathematical Analysis, Narosa Publishing House, N.Delhi, (2010)

M.Sc. Mathematics with Computer Science, Semester – I

MTM-1.2	Abstract Algebra	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Groups, order of an element of a group, Subgroups, Cyclic groups, Cosets, Normal subgroups, Quotient groups, Homomorphisms, Isomorphisms Permutation groups.

Unit-II Cayley's Theorem, Automorphisms, Normalizer and centre, Conjugate classes, Class equation and its applications, Direct products, Sylow's theorems, Finite abelian groups, Normal Series and Solvable Groups.

Unit-III Rings, Subrings, Ideals, Integral Domain and their properties, Quotient Rings, Ring Homomorphisms, Isomorphisms, Ring of Polynomials and their properties.

Unit-IV Principal Ideal Domain, Euclidean Domain, Unique Factorization Domain, Primitive Polynomials, Gauss' lemma, Eisenstein's criterion for Irreducibility.

Books Recommended

1. I. N. Herstein, Topics in Algebra, John Wiley & Sons. 2006.
2. Surjeet Singh and Qazi Zameeruddin, Modern Algebra, Vikas Publications., 2003.
3. N. Jacobson, Basic Algebra Vol I & II (2^{nd} Edition), Dover Books on Mathematics. 1984.
4. D. A. R. Wallace, Groups, Rings and Fields, Series: Springer Undergraduate Mathematics Series, 2001.
5. N. H. McCoy: Theory of rings, Chelsea Pub. Co., 1973.

M.Sc. Mathematics with Computer Science, Semester – I

MTM-1.3C$_1$	**Discrete Mathematical Structures**	**Unit**	**Credit**	**Lecture/ week**
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Relations and Functions, Equivalence Relations, Partial Order, Recurrence Relations, Solutions of Linear homogeneous Recurrence Relations, Introduction to Mathematical Logic, Propositional Calculus.

Unit-II Lattices and Boolean algebra, Boolean Functions, Connonical Form (Disjunctive Normal Form) of a Boolean function, Karnaugh Maps.

Unit-III Graphs and their representations, Walk, Path, Cycle, Circuit, Eulerian Graphs, Connected Graphs, Planar Graphs, Trees, Spanning trees, Binary Tree Traversals.

Unit-IV Linear codes, Hamming Code, Generator and parity check matrix, Hamming distance standard array and Syndrome decoding, introduction to cyclic codes.

Books Recommended

1. Discrete Mathematics, K.A. Ross, Charles R.W. Wright, Prentice Hall Inc.
2. Discrete Mathematical Structure for Computer Sciences, Bernard Kolman / Robert C. Bus, Prentice Hall of India.
3. Theory of Error Correcting Codes, F.J. Mac. Williams / N.J.A.Sloane, North Holland Pub. Co.
4. Graph Theory with Applications to Engineering and Computer Science, Narsingh Deo, Prentice Hall of India.

M.Sc. Mathematics with Computer Science, Semester – I

MTM-1.3C_2	Computer Organization and Architecture	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Number Systems, Binary Arithmetic, Fixed-point and Floating-point representation of numbers, Codes, Complements, Character Representation – ASCII, EBCDIC. Boolean Algebra: Basic Definitions, Axiomatic definition of Boolean Algebra, Basic theorems and Properties of Boolean Algebra, Boolean functions, Canonical and Standard Forms.

Unit-II Basic Gates – AND, OR, NOT, Universal Gates – NAND, NOR, Other Gates – XOR, XNOR etc. NAND, NOR implementations of digital circuits, Simplification Of Boolean Expressions: Formulation of simplification problem, Karnaugh Maps, Minimal, Combinational Logic Design Procedure, Adders, Subtractors, Code Conversion, Decimal Adder, Magnitude Comparator, Decoders, Encoder, Multiplexers, De-multiplexer.

Unit-III Flip-Flops, Clocked RS, D type, JK, T type, State table, state diagram and state equations. Flip-flop excitation tables. Design Procedure, Design of sequential circuit and Counters, Shift registers, Synchronous Counters.

Unit-IV Primary Memory, Secondary memory, Cache memory, Memory Hierarchy, Basic architecture of computer, Bus structures, Von Neumann concept. Overview of Microprogramming, Addressing modes, Pipelining, Synchronous and Asynchronous Data transfer, DMA data transfer.

Books Recommended

1. M.Morris Mano : Computer System Architecture, Prentice Hall of India.
2. William Stalling, "Computer Organization and Architecture" Pearson Education 15 / 36 V.
3. Andrew S. Tanenbaum, Structured Computer Organization, Prentice Hall of India Pvt. Ltd.
4. J. P. Hayes "Computer Architecture and Organization" McGraw Hill Education India.
5. M. Morris Mano, 'Computer Engineering Hardware Design', PHI.
6. V.Rajaraman, T. Radhakrishnan, An Introduction to Digital Computer Design, Prentice Hall of India Pvt. Ltd.
7. Nicholas Carter, Schaum's Outlines Computer Architecture, Tata MH.
8. Carl Hamacher, Zvonko Vranesic, Safwat Zaky, "Computer Organization", 5th Edition, Mc Graw-Hill Education India
9. M.Morris Mano, 'Digital Logic and Computer Design', PHI. 10. Donald e Givone, Digital principles and Design, TMH (Unit II and V)
10. Donald e Givone, Digital principles and Design, TMH (Unit II and V)

M.Sc. Mathematics with Computer Science, Semester – I

MTM-1.4	Computer Fundamentals & C Programming	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Introduction to Computers, Program, Software, Algorithms, Flow Charts. Introduction to C, Character Set, C Token, Identifier & Keyword, Constants, Variables, Data Types, Data Declaration & Definition, Operators & Expression - Arithmetic, Relational, Logical, Increment & Decrement, Bit wise, Assignment, Conditional.

Unit-II Precedence & Associativity of Operators, Type Conversions - Implicit and Explicit, Console I/O, Control and Selection Statements - If, Nested if, if-else-if, The Alternative -Conditional Expression, Switch, Nested Switch, Iteration Statements for loop, while loop, do-while loop, break, continue, goto statements. Single dimensional and Multi-dimensional Arrays - Accessing array elements, Initializing an array, Strings using arrays.

Unit-III Pointers – Introduction, Declaration of Pointer, Initializing Pointer, De-referencing Pointer, Pointer to Pointer, Array of Pointers, Strings using pointers.

Introduction to functions, User-Defined Function, Function Prototype, Definition of Function, Arguments & local variables, Returning and Calling Function by reference & Call by value, Passing Arrays & Strings to Function, Returning Multiple Values, Recursive Functions.

Unit-IV Storage Class & Scope, Structures, Declaration and Initializing Structure, Accessing Structure members, Structure, Assignments, Arrays of Structure, Passing Structure to function, Structure Pointer, Unions, Enumeration, File handling: Introduction, Opening a File, Closing a File, Input/ Output Operations on Files, Command Line Arguments.

Books Recommended

1. Sinha, P.K. & Sinha, Priti, "Computer Fundamentals", BPB, 2007.
2. Rajaraman, V., "Fundamentals of Computers", PHI, 2010.
3. E Balagruswamy, Programming in ANSI C, Tata McGraw Hill, 2011.
4. Gottfried, Byron S., Programming with C, Tata McGraw Hill, 2011.
5. Yashwant Kanetker, Let us C, BPB, 2007.
6. Yashwant Kanetker, Pointers in C, BPB, 2007.
7. R G Dromey, How to Solve by Computer, Pearson Education, 2007.
8. Deitel & Deitel, C: How to Program, Pearson Education, 2003.

M.Sc. Mathematics with Computer Science, Semester – I

MTM-1.5	Numerical Analysis	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Newton-Raphson method for Complex roots, Solution of system of nonlinear equations by Seidal Iteration method, Newton-Raphson method. Lagrange's form of interpolating polynomial, Existence and uniqueness of interpolating polynomial, Hermite, Piecewise and Cubic spline interpolation.

Unit-II Approximation: Weighted least squares approximation, Method of least squares for continuous functions, Gram-Schmidt orthogonalization process, Approximation of functions using Chebyshev polynomials. Numerical integration: Romberg's method, Guass Quadrature formula and error estimation.

Unit-III Numerical solution of Initial Value Problems: Runge-Kutta method of order four for system of equations, second and higher order differential equations, Boundary Value problems by Shooting method, Finite difference method, Convergence of finite difference scheme, Stability Analysis.

Unit-IV Numerical solution of partial differential equations: Parabolic equations- explicit methods and Crank-Nicolson method with stability analysis. Elliptic equations- Standard five point formula, Jacobi's iteration method and Leibmann's method, Hyperbolic equations: Explicit finite difference method.

Books Recommended

1. Gerald & Wheatlay: Applied Numerical Analysis, Pearson.
2. M. K. Jain, S.R.K Iyengar and R. K. Jain, *Numerical Methods for Scientific and Engineering Computations*, New Age Int., New Delhi.
3. G.D. Smith, *Numerical Solutions of Partial Differential Equations*, Clarendon Press Oxford.
4. S.D. Conte & Carl De Boor, Elementary Numerical Analysis, McGraw Hill, NY
5. Naseem Ahmad, Fundamentals Numerical Analysis with error estimation

M.Sc. Mathematics with Computer Science, Semester – II

MTM-2.1	Topology	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Definition and examples of topological spaces, Neighbourhood of a point, Open and Closed sets, Closure, Interior, Exterior and boundary, Limit points, Derived sets, Bases and subbases, I and II countable space, Lindelof space, Separable space, Continuity, Homeomorphism, Subspaces, product spaces and quotient spaces.

Unit-II Compactness, Continuous functions and compact sets. Finite intersection property, Heine Borel theorem, Locally compact spaces, Bolzano Weierstrass property.

Unit-III Separation Axioms, T_i (i = 0,1,2,3,4) spaces, Regular and completely regular spaces, Normal and completely normal spaces, Urysohn's lemma, Tietze extension theorem.

Unit-IV Connected and Disconnected space, Examples, Components, Locally connected spaces, Closure of a connected space, Totally disconnected spaces.

Books Recommended

1. G.F. Simmons, Introduction to Topology and modern Analysis, McGraw Hill Book Company, 1963
2. J. R. Munkres, Topology, A First course, Prentice Hall of India Pvt. Ltd., New Delhi, 2000
3. C. Adams and R. Franzosa, Introduction to Topology, Pure and Applied, Pearson Prentice Hall.

M.Sc. Mathematics with Computer Science, Semester – II

MTM-2.2	Linear Algebra	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Vector Space, Subspaces and properties, Basis and Dimensions, Sum and direct sum of Subspaces, Independent Subspaces, Quotient Space, Linear transformations, Rank and Nullity of a linear transformation, Sylvester's law of nullity.

Unit-II Algebra of linear transformations, $\mathrm{Hom}(U,V)$, Singular and Non-singular linear transformations, Invertible linear transformations, Dual spaces, Principle of duality, Bidual, Annihilators.

Unit-III Matrix of a linear transformation, Change of Basis, Equivalent and Similar matrices, Relationship between $\mathrm{Hom}(U,V)$ and $M_{m,n}(F)$, Minimal polynomials of a linear transformation and its properties, Cyclic Space.

Unit-IV Eigen values and Eigen vectors, Inner product spaces, Orthogonality and Orthonormality, Schwarz inequality, Gram-Schmidt orthogonalization process, Adjoint, Hermitian, Unitary and Normal linear operators.

Books Recommended

1. I. N. Herstein: Topics in Algebra, John Wiley & Sons. 2006.
2. P. R. Halmos: Linear Algebra Problem Book, (Dolciani Mathematical Expositions), Number 16, The Mathematical Association of America, 1995.
3. Hoffman & Kunze: Linear Algebra, PHI, 1971.
4. Surjeet Singh & Q Zameeruddin: Modern Algebra, Vikas Publications., 2003.

M.Sc. Mathematics with Computer Science, Semester – II

MTM-2.3	Differential Equations and Applications	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Existence & uniqueness theorem, General theory of Homogenous and nonhomogeneous equations with constant coefficients, Theory of equations with variable coefficients, Method of variation parameter and the formula for particular integral in terms of Wronskian.

Unit-II Series Solution of second order linear differential equations near ordinary point, Singularity and the solution in the neighborhood of regular singular point, Euler equation and Frobenious method, Solution of Legendre, Bessel, Hermite and Lagurre differential equations.

Unit-III Formulation of heat conduction equation and its solution by the method of separation of variables, Steady state condition and the solution of heat conduction problem with non-zero end conditions, Formation of wave equation and its solution by the method of separation of variables

Unit-IV Linear homogeneous boundary value problems, Eigen values and Eigen functions, Sturm Liouville boundary value problems, Non-homogeneous boundary value problems, Green's functions and the solution of boundary value problems in terms of Green's functions.

Books Recommended

1. Earl A. Coddington, An Introduction to Ordinary Differential Equation.
2. Boyce and Diprime., Elementary Differential Equations and Boundary Value Problems.
3. E. Weinberger, A first course in partial differential equations

M.Sc. Mathematics with Computer Science, Semester – II

MTM-2.4C$_1$	**Data Structures in C**	**Unit**	**Credit**	**Lecture/ week**
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Definition of Data Structure, Types of Data Structures, Abstract Data Type (ADT), Algorithms: Algorithm Concepts, Definition of Algorithm, Objectives of Algorithms, Quality of an Algorithm, Space Complexity and Time Complexity of an Algorithm, Introduction to Arrays, Row and Column Major Implementations of 1 - D, 2-D, 3-D Arrays, Searching in Arrays - Linear Search, Binary Search, Hash Tables.

Unit-II Sorting in arrays - Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort, Concept of a Linked List, Linear Single and Double Linked Lists, Circular linked List, Operations on Linked Lists and implementation in C, Applications of Linked List. Introduction to Stacks, Operations on Stack, Stack Implementation in C, Applications of Stack.

Unit-III Introduction to Queues, Types of Queues: Linear Queue, Circular Queue, Priority Queue, Double Ended Queue, Operations on Queues, Queue Implementation in C, Concept of a Tree, Definitions and Examples of n-ary Tree, Binary Tree, Strictly Binary Tree, Complete Binary Tree, Almost Complete Binary Tree. Level of a Node, Height and Depth of a Tree, Binary Search Tree, Operation on Trees, Tree Traversal and Search Algorithm with Implementation in C, AVL Tree, B Tree, B+ Tree, Heap Tree.

Unit-IV Huffman Algorithm. Definitions of Vertex, Edge and Graph, Types of Graphs – Directed and Undirected, Connected and Disconnected, Cyclic and Acyclic, Isomorphic Graphs. Representation of Graphs: Adjacency Matrix, Linked List. Incidence Matrix, Path Matrix. Graph Algorithms – Breadth First Search (BFS), Depth First Search (DFS), Spanning tree, Minimum spanning tree (MST), Kruskal's Algorithm, Prim's Algorithm and Shortest Path Algorithms.

Books Recommended:

1. Data Structures by S. Lipshutz, Schaum outline series, Tata Mc-graw Hill
2. Classic Data Structures by D. Samanta, PHI
3. Data Structures Using C & C++ by Tananbaum
4. Introduction to Algorithms Cormen, Leiserson, Rivest.

M.Sc. Mathematics with Computer Science, Semester – II

MTM-2.4C$_2$ Data Structures in Java	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.	4	4	4

Unit-I Definition and Types of Data Structure, Abstract Data Type (ADT), Algorithms: Algorithm Concepts, Definition of Algorithm, Objectives of Algorithms, Quality of an Algorithm, Space Complexity and Time Complexity of an Algorithm, Introduction to Arrays, Row and Column Major Implementation of Multi-Dimensional Arrays, Searching in Arrays - Linear Search, Binary Search.

Unit-II Sorting in Arrays - Bubble Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort. Introduction to Java Collections Framework: Interfaces (Set, List, Queue, Deque etc.) and Classes (ArrayList, Vector, LinkedList, HashSet, LinkedHashSet etc.). Ordered and Unordered Implementations of Lists and their Applications. Introduction to Stacks, Operations on Stack, Stack Implementations In Java, Applications of Stack.

Unit-III Introduction to Queues, Types of Queues - Linear Queue, Circular Queue, Priority Queue, Double Ended Queue, Operations on Queues, Queue Implementations in Java. Concept of a Tree, Definitions and Examples of n-ary Tree, Binary Trees, Strictly Binary Tree, Complete Binary Tree, Full Binary Tree, Level of a Node, Height and Depth of a Tree, Binary Search Trees, Operation on Trees, Tree Traversals and Search Algorithm with Implementation in Java, AVL Tree, B-Tree, B+ Tree, Heap Tree.

Unit-IV Huffman Algorithm. Definitions of Vertex, Edge and Graph, Types of Graphs – Directed and Undirected, Connected and Disconnected, Cyclic and Acyclic, Isomorphic Graph, Representation of Graphs: Adjacency Matrix, Linked List. Incidence Matrix, Path Matrix. Graph Algorithms – Breadth First Search (BFS), Depth First Search (DFS), Spanning Tree, Minimum Spanning Tree (MST), Kruskal's Algorithm, Prim's Algorithm, and Shortest Path Algorithms.

Books Recommended:

1. Data Structures by S. Lipshutz, Schaum outline series, Tata Mc-graw Hill.
2. Classic Data Structures by D. Samanta, PHI Publication.
3. Data Structures & Algorithms in Java by Robert Lafore, Pearson.
4. Data Structures with Java by John R. Hubbard and Huray Anita, PHI.
5. Data Structures and Algorithms Analysis in Java, Mark Allen Weiss, Pearson Education, 3rd Edition.
6. Introduction to Algorithms, Cormen, Leiserson, Rivest.

M.Sc. Mathematics with Computer Science, Semester – II

MTM-2.5SE	Object Oriented Programming- Java (Skill Enhancement)	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Paradigms of Programming Languages, Basic Concepts of Object Oriented Approach, Comparison of Object Oriented and Procedure Oriented Approach, Benefits and Applications of Object Oriented Programming. Introduction to Java, Basic Features of Java, Java Virtual Machine, Java Runtime Environment, Primitive Data Type and Variables, Expressions, Statements and Arrays, Operators, Control Statements.

Unit-II Encapsulation, Classes and Objects, Class Members: Data Members and Member Functions. Class Member Visibility, Understanding Static, Constructors, Argument Passing, Object Initialisation, Garbage Collection. Polymorphism: Ad hoc and Universal Polymorphism. Inheritance Basics: Access Control, Use of Super, Types of Inheritance, Method Overriding, Dynamic Method Dispatching, Preventing Inheritance and Overriding.

Unit-III Defining and Implementing an Interface, Applying Interface, Accession of Interface Variable, Abstract Class. Java API Packages, Using System Packages, Naming Conventions, Creating Packages, Accessing a Package, Adding a Class to a Package. Exception Types, Exception Handling, Catching Multiple Exceptions, Java Built-in Exception, Creating Exception Subclasses.

Unit-IV Multithreading, Main Thread, Creating Threads, Thread Priorities, Life Cycle of Thread, Synchronization in Java, Thread Exceptions, String: Fundamental of Characters and Strings, String and StringBuffer Classes, Introduction to Applet Programming.

Books Recommended:

1. Cay Horstmann, Computing Concepts with Java Essentials (5th ed.), John Wiley & Sons.
2. Bruce Eckel, Thinking in Java, Pearson Education.
3. H. Schildt, Java 2: The Complete Reference (5th ed.), Tata McGraw Hill.
4. Richard Johnson, An Introduction to Java Programming and Object-Oriented Application Development, Thomson Learning.
5. Cay S. Horstmann & Gary Cornell, Core Java Volume I (7th ed.), Sun Microsystems Press Java Series.
6. Deitel & Deitel, Java-How to Program (7th ed.), Prentice Hall.
7. Daniel Liang, Introduction to Java Programming (5th ed.), Prentice Hall.
8. J.A. Slack, Programming and Problem Solving with Java, Thomson Learning.