Department of Mathematics
Faculty of Natural Science, Jamia Millia Islamia, New Delhi-25
Course Structure of M.Sc. Tech. (Industrial Mathematics with Computer Applications)

Semester – I

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	MST-1.1	Real Analysis	4	4	25	75	100
2	MST-1.2	Differential Equations and Applications	4	4	25	75	100
3	MST-1.3C_1[#]	Discrete Mathematical Structures	4	4	25	75	100
	MST-1.3C_2[#]	Financial Mathematics					
4	MST-1.4	Computer Fundamentals & C Programming	4	4	25	75	100
5	MST-1.5	Numerical Analysis	4	4	25	75	100
6	*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	MST-2.1	Linear Algebra	4	4	25	75	100
2	MST-2.2	Operations Research	4	4	25	75	100
3	MST-2.3	Operating Systems	4	4	25	75	100
4	MST-2.4	Digital Logic and Computer Architecture	4	4	25	75	100
5	MST-2.5C_1[#]	Data Structures in C	4	4	25	75	100
	MST-2.5C_2[#]	Data Structures in C++					
6	MST-2.6AE[#]	Soft Skills	4	4	25	75	100
7	*Lab-II*	*Data Structures using C/ C++*	-	2	25	25	50

Semester – III

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	MST-3.1	Topology	4	4	25	75	100
2	MST-3.2	Computer Networks	4	4	25	75	100
3	MST-3.3	Database Management System	4	4	25	75	100
4	MST-3.4	Integral Transforms and Boundary Valued Problems	4	4	25	75	100
5	MST-3.5SE[#]	Object Oriented Programming using Java	4	3+1	25	75	100
6	*Lab-III*	*DBMS Lab*	-	2	25	25	50

Semester – IV

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	MST-4.1	Functional Analysis	4	4	25	75	100
2	MST-4.2	Complex Analysis	4	4	25	75	100
3	MST-4.3	Formal Languages and Automata Theory	4	4	25	75	100
4	MST-4.4	Software Engineering	4	4	25	75	100
5	MST-4.5SE[#]	Internet Technologies	4	3+1	25	75	100
6	*Lab-IV*	*Minor Project*	-	2	25	25	50

Semester – V

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	MST-5.1	Curves, Surfaces and Applications	4	4	25	75	100
2	MST-5.2	Analysis and Design of Algorithm	4	4	25	75	100
3	MST-5.3	Data Mining	4	4	25	75	100
4	MST-5.4	Artificial Intelligence	4	4	25	75	100
5	MST-5.5AE#	Computer Graphics	4	3+1	25	75	100
6	*Lab-V*	*MatLab*	-	2	25	25	50

Semester – VI

S. No.	Code	Title of paper	Unit	Credit	Internal Assessment	Semester Examination	Total Marks
1	MST-6.1 MP	*Major Project + Viva Voce*	-	12			300*

***Distribution of project evaluation marks**
1. Project Report- : 50%
2. Presentation- : 25%
3. Viva-Voce -: 25%

#C: Choice Based
#AE: Ability Enhancement
#SE: Skill Enhancement

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – I

MST-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, Cantorôs 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 functions, Comparison of Riemann and Lebesgue integrals, Properties of Lebesgue integral for bounded measurable functions, The Lebesgue integral for unbounded functions, Integral of non-negative measurable functions, General Lebesgue integral, Improper integrals.

Unit-IV Point wise convergence, Convergence almost everywhere, Uniform convergence almost everywhere, Convergence in measure, F. Reiszôs theorem on convergence a.e., D.F. Egoroffôs theorem, Lebesgue bounded convergence theorem, Lebesgue dominated convergence theorem, Fatouôs lemma, Monotone convergence theorem.

L^P-spaces, Properties of L^P-spaces, Holderôs inequality, Minkowskiôs inequality and Schwartzôs inequality, Convergence in the mean, Riesz-Fischer theorem.

Books Recommended

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

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – I

MST-1.2	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 neighbourhood 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, Greenôs functions and the solution of boundary value problems in terms of Greenôs functions.

Books Recommended

1. Earl A. Coddington, *An Introduction to Ordinary Differential Equation*, Dover Publications, INC., 2012.
2. Boyce and Diprime, *Elementary Differential Equations and Boundary Value Problems*, Wiley, 2008.
3. H. F. Weinberger, *A First Course in Partial Differential Equations: with Complex Variables and Transform Methods (Dover Books on Mathematics),* Dover Publications, 1995.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – I

MST-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, Booleanf, 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. K.A. Ross, Charles R.W. Wright, *Discrete Mathematics*, 5th edition, PHI, 2002.
2. Bernard Kolman, Robert C. Busby, *Discrete Mathematical Structure for Computer Sciences*, Prentice Hall of India, 1987.
3. F.J. Mac. Williams, N. J. A. Sloane, *Theory of Error Correcting Codes*, North Holland Pub. Co., 1978.
4. Narsingh Deo, *Graph Theory with Applications to Engineering and Computer Science*, Prentice Hall of India, 1979.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – I

MST-1.3C_2 Financial Mathematics	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.	4	4	4

Unit-I The accumulation and amount functions, The effective rate of interest, Simple interest, Compound interest, Present value, The effective rate of discount, Nominal rates of interest and discount, Forces of interest and discount, Varying interest, Equation of value, Unknown time, Unknown rate of interest, Determining time periods, Practical examples.

Unit-II Annuity-immediate, Annuity-due, Annuity values on any date, Perpetuities, Unknown time, Unknown rate of interest, Varying interest, Annuitiesnot involving compound interest. Differing payment and interest conversion periods, Annuities payableless frequently than interest convertible, Annuities payable more frequently thaninterest convertible, Continuous annuities, Payments varying in arithmetic progression, Payments varying in geometric progression.

Unit-III Finding the outstanding loan balance, Amortization schedules, Sinkingfunds, Differing payment periods and interest conversion periods, Varying series of payments, Amortization with continuous payments, Step-rate amounts of principal.

Unit-IV Types of securities, Price of a bond, Premium and discount, Valuation between coupon payment dates, Determination of yields rates, Callable and putablebonds, Serial bonds, some generalizations, other securities, Valuation of securities, Discounted cash flow analysis, Uniqueness of the yield rate, Reinvestment rates, Interest measurement of a fund.

Books Recommended:

1. Stephen G. Kellison, *The Theory of Interest*, 3rd Edition. McGraw Hill International Edition, 2009.
2. R. J. Elliott and P. E. Kopp, *Mathematics of Financial Markets*, Springer, 1999.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – I

MST-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 ï Introduction, Declaration of Pointer, Initializing Pointer, De-referencing Pointer, Pointer to Pointer, Array of Pointers, Strings using pointers.

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. P. K Sinha & Sinha, Priti, *Computer Fundamentals*, BPB, 2007.
2. V., Rajaraman, *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. Tech. Industrial Mathematics with Computer Applications, Semester – I

MST-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, Lagrangeôs 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: Rombergôs 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, Jacobiôs iteration method and Leibmannôs method, Hyperbolic equations: Explicit finite difference method.

Books Recommended

1. Gerald & Wheatlay, *Applied Numerical Analysis*, Pearson, 2004.
2. M. K. Jain, S.R.K Iyengar and R. K. Jain, *Numerical Methods for Scientific and Engineering Computations*, New Age Int., New Delhi, 2010.
3. G.D. Smith, *Numerical Solutions of Partial Differential Equations*, Clarendon Press Oxford, 1985.
4. S.D. Conte & Carl De Boor, *Elementary Numerical Analysis*, McGraw Hill, 2005.
5. Naseem Ahmad, *Fundamentals Numerical Analysis with error estimation*, Anamaya Publishers, 2010.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – II

MST-2.1	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, Sylvesterôs 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 $M_{\square,\square}F_{\square}$, 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 & Qazi Zameeruddin, *Modern Algebra*, Vikas Publications., 2003.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – II

MST-2.2	Operations Research	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Convex sets and their properties, Graphical method, Integer Programming, Branch and Bound Technique, Theory of Simplex method, Two-Phase Simplex Method, Big-M method.

Unit-II Duality in LP, Conversion of primal to dual, Dual Simplex method, Sensitivity analysis, Discrete change in price vector, requirement vector and coefficient matrix, adding a new variable and new constraints.

Unit-III Queuing Theory, Distribution of arrival and departure pattern, (M/M/1):(Đ/FCFS), (M/M/1):(N/FCFS) and (M/M/S):(Đ/FCFS) queuing models, Network analysis, Critical Path Method (CPM), Project Evaluation and Review Technique (PERT), Project management with CPM/PERT.

Unit-IV Dynamic programming, Bellmanôs Principle of Optimality, Nonlinear Programming (NLP), Graphical method for NLP, Kuhn-Tucker Conditions for Constrained Optimization, Quadratic Programming, Wolfeôs modified Simplex method, Separable Programming.

Books Recommended:

1. H. A. Taha, *Operations Research*, 9th edition, Pearson Education, 2014.
2. Hillier and Lieberman, *Introduction to Operations Research*, McGraw Hill, 1995.
3. S. D. Sharma, *Operations Research*, KedarNath Ram Nath Publishers.
4. J. K. Sharma, *Operations Research – Theory and Application*, Macmillian Publication, 2009.
5. S. M. Sinha, *Mathematical Programming*, Elsevier India Pvt. Ltd., 2005.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – II

MST-2.3	Operating Systems	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Introduction, Evolution of Operating System, Role and Functions of Operating Systems, Operating System Classification, Operating System Structure, Definition of Multiprogramming, Multitasking, Multiprocessing, Multi-user, Timesharing, Multithreading.

Unit-II Process Overview, Process States and State Transitions, Levels of Schedulers and Scheduling Algorithms. Process Communication, Process Synchronization, Semaphores, Critical Section and Mutual Exclusion Problem, Classical Synchronization Problems, Multithreading. Introduction to Deadlock, Coffmanǿs Conditions for deadlock, Deadlock Detection and Recovery, Deadlock Prevention, Deadlock Avoidance.

Unit-III Classical Memory Management Techniques- Monoprogramming, Multiprogramming with fixed and variable partitions, Relocation & Protection, Swapping, Internal and External Fragmentation, Memory Compaction, Virtual Memory - Paging, Page Table, Page Replacement Policies, Segmentation, Thrashing.

Unit-IV File Concept, File Operations, Access Methods, Directory Structure, File-System Mounting, File Sharing, File-system Structure, File-System Implementation, Directory Implementation, Disk-block Allocation Methods, Free-Space Management. Disk structure, Disk Scheduling Algorithms- FCFS, SSTF, SCAN, C-SCAN, LOOK, C- LOOK.

Books Recommended:

1. A.S. Tanenbaum, *Modern Operating Systems*, Pearson Education, 3rd edition, 2015.
2. Silberschatz, P.B.Galvin and G. Gagne, *Operating System Concepts*, Wiley, 2009.
3. William Stallings, *Operating Systems: Internals and Design Principles*, PHI, 2009.
4. D.M. Dhamdhere, *Operating Systems: A Concept Based Approach*, Tata McGraw-Hill, 2007.
5. Deitel Deitel Choffnes, *Operating Systems*, Pearson, 2004.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – II

MST-2.4	Digital Logic and computer Architecture	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Information Representation: Number Systems - Binary, Hexal , Octal, Nano, Decimal, and Decimal; Number Base Conversions; Complements; Binary Arithmetic; number normalization, Floating-point Representation; Binary Codes for Decimal Digits: BCD Code, Excess-3 Code, 84-2-1 Code, 2421 Code, Reflected Code; Error Detection Code; Character Representation ï ASCII, EBCDIC.

Boolean Algebra, and Logic Gates: Boolean Algebra-Basic Definitions, Algebra, Basic Theorems and Properties of Boolean Algebra.

Unit-II Digital Logic Gates: Basic Gates ï AND, OR, NOT, NAND, NOR, T Gate, XOR, XNOR; Implementation of Boolean Functions With T gate, NAND and NOR gate.

Simplification of Boolean Functions and Combinational Logic: Boolean Functions: Basic Definition, Literals, Minimization of Boolean Functions; Karnaugh Maps (K-Map) Method: Two Variable K-Map, Three Variable K-Map, Four Variable K-Map, Product of Sum Simplification.

Combinational Logic: Combinational Logic Design Procedure; Design of Some Standard Combinational Circuits: Half Adder, Full Adder, Half Subtractor, Full Subtractor, Code Conversion; Decimal Adder, BCD Adder, Magnitude Comparator, Decoders, Encoder, Multiplexers, De-multiplexer, Threshold circuit.

Unit-III Sequential Logic: Flip-Flops: RS Flip Flop, Clocked RS, JK Flip Flop, D Type Flip Flop, T Type Flip Flop; Analysis of Clocked Sequential Circuits: State Table, State Diagram, State Equations; Flip Flop Excitation Tables; Design of Sequential Circuits; Counter: Binary Counter, BCD Counter, Design of Counters.

Unit-IV Memory: Primary Memory, Secondary memory, cache memory, Memory Hierarchy; Basic Architecture: Overview of computer architecture; Bus structure, Von Newman concepts, Micro engine, Microprogramming, Addressing mode, Pipeline, Synchronous and Asynchronous Data transfer, DMA data transfer, Machine zero, Machine one, Machine two and Machine three.

Books Recommended:

1. M. Morris Mano, *Computer System Architecture*, Pearson, 2008.
2. Donald E. Givone, *Digital Principles and Design*, Tata McGraw Hill, 2002.
3. V. Rajaraman & T. Radhakrishnan, *An Introduction to Digital Computer Design*, PHI, 2007.
4. M. Alam and B. Alam, *Digital Logic Design*, PHI, 2015.
5. Rafiquzzaman & Chandra, *Modern Computer Architecture*, BPB, 2003.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – II

MST-2.5C_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 ï Directed and Undirected, Connected and Disconnected, Cyclic and Acyclic, Isomorphic Graphs. Representation of Graphs: Adjacency Matrix, Linked List. Incidence Matrix, Path Matrix. Graph Algorithms ï Breadth First Search (BFS), Depth First Search (DFS), Spanning Tree, Minimum Spanning Tree (MST), Kruskalôs Algorithm, Primôs Algorithm and Shortest Path Algorithms.

Books Recommended:

1. S. Lipshutz, Data Structures, *Schaum outline series*, McGraw-Hill, 2011.
2. D. Samanta, *Classic Data Structures*, PHI, 2006.
3. Yashavant P. Kanetkar, *Data Structures through C*, Second Edition, BPB, 2003.
4. A. M. Tanenbaum, *Data Structures Using C and C++*, Prentice-Hall, Inc., New Jersey, 1998.
5. Cormen, Leiserson, Rivest and Stein, *Introduction to Algorithms*, 2nd Edition, McGraw-Hill, 2009.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – II

MST-2.5C$_2$ 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 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. 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 Implementations 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 Implementations in C++. 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 C++, AVL Tree, B-Tree, B+ Tree, Heap Tree.

Unit-IV Huffman Algorithm. Definitions of Vertex, Edge and Graph, Types of Graphs ï 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), Kruskalôs Algorithm, Primôs Algorithm, and Shortest Path Algorithms.

Books Recommended:

1. S. Lipshutz, Data Structures, *Schaum outline series*, McGraw-Hill, 2011.
2. D. Samanta, *Classic Data Structures*, PHI, 2006.
3. A.M. Tanenbaum, *Data Structures Using C and C++*, Prentice-Hall, Inc., New Jersey, 1998.
4. Cormen, Leiserson, Rivest and Stein, *Introduction to Algorithms*, 2nd Edition, McGraw-Hill, 2009.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – II

MST-2.6AE	Soft Skills (Ability Enhancement)	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Self Development and Assessment: Self-Assessment, Self-Awareness, Perception and Attitudes, Values and Belief System, Personal Goal Setting, Career Planning, Self-esteem, Building of Self-Confidence.

Unit-II Communication Skill: Components of Communication, Principles of Communication, Barriers, Listening Skills. Verbal Communication - Planning, Preparation, Delivery, Feedback and Assessment of Activities Like Public Speaking, Group Discussion, Presentation Skills, Perfect Interview, Listening and observation Skills, Body language.

Unit-III Written Communication: Technical Writing ï Technical Reports, Project Proposals, Brochures, Newsletters, Technical Articles, Technical Manuals, Official/Business Correspondence, Business Letters, Memos, Progress Report, Minutes of Meeting, Event Reporting, Use of Style, Grammar and Vocabulary for Effective Technical Writing, Use of Tools, Guidelines for Technical Writing, Publishing.

Unit-IV Ethics, Etiquettes and Other Skills: Business Ethics, Etiquettes in social as well as Office settings, Email etiquettes, Telephone Etiquettes, Engineering ethics and ethics as an IT professional, Civic Sense, Managing time, Improving Personal Memory, Study Skills that Include Rapid Reading, Notes Taking, Complex Problem Solving, Creativity.

Books Recommended:

1. Shiv Khera, *You Can Win*, Macmillan Books, 2003.
2. Stephen Covey, *The 7 Habits of Highly Effective People: Powerful Lessons in Personal Change,* Free Press, 2004.
3. John Collin, *Perfect Presentation*, AMACOM, 1999.
4. Jenny Rogers, *Effective Interviews*, AMACOM, 1999.
5. Raman and Sharma, *Technical Communications*, Oxford University Press, 2008.
6. Sharon Gerson and Steven Gerson, *Technical writing: Process and Product*, Prentice Hall, 2005.
7. R. Sharma and K. Mohan, *Business correspondence and report writing*, McGraw Hill Education, 2010.
8. XEBEC, *Presentation Book 1, 2, 3*, Tata McGraw-Hill, 2000.
9. Sheila Cameron, *The Business Students Handbook: Skills for Study and Employment*, Prentice Hall, 2009.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – III

MST-3.1	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, Urysohnôs 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, 2008.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – III

MST-3.2	Computer Networks	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Network categorization and Hardware: Broadcast and point-to point networks, Network Topology, Local Area Network (LAN), Metropolitan Area Network (MAN), Wide Area Networks (WAN), Inter Networks, Network Software: Protocols, Services, Network Architecture, design issues, OSI Reference Model, TCP/IP Reference Model, review of different layer services, comparison of OSI and TCP/IP model.

Unit-II The Physical Layer: different transmission media, guided transmission media- twisted pair cable, coaxial cable, fiber-optics, wireless transmission- radio waves, micro waves, infrared waves; satellite communication, network topologies and architecture, Connectivity devices: Introduction to modems, switch, hub, repeater, gateways, routers, network adopter card, line coding, switching, multiplexing, digital to analog data and signals, bit rate baud, band width.

Unit-III Date Link Layer: Framing, Error detection and correction, flow control, data link protocol, stop and wait protocol, sliding window protocol: A one-bit sliding window protocol, A protocol using go back-N, A protocol using selective repeat, examples of data link protocols: HDLC(High Level Data Link Control), Medium Access Sub Layer: channel allocation, ALOHA- pure ALOHA, slotted ALOHA, Medium Access Control, Carrier Sense Multiple Access, CSMA with Collision Detection, wireless LAN protocol, IEEE standards 802 for LANs.

Unit-IV Network Layer: services provided to the transport layer, routing algorithms, shortest path routing, flooding algorithms, Congestion, IP protocol, IP address; Transport Layer: design issues, transport protocols: Inter transport protocol- Transmission Control Protocol (TCP),User Datagram Protocol (UDP);Application Layer: application layer services and protocols- Domain Name System (DNS), electronic mail, file transfer protocol, hypertext transfer protocol, Introduction to Network Security and Cryptography (DES, RSA algorithms), Communication Security(Firewalls).

Books Recommended:

1. B.A. Forouzan, *Data Communication and Networking*, TMH, 4th Ed., 2006.
2. A.S. Tananbaum, *Computer Networks*, 4th Ed., Pearson, 2003.
3. W. Stallings, *Data and Computer Communications*, 7th Ed., Pearson, 2002.
4. C. E. Doughlas, *Computer Networks and Internet*, 2nd Ed., Pearson, 2000.
5. U. Black, *Computer Networks- Protocols, Standards and Interfaces*, PHI, 1996.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – III

MST-3.3	Database Management Systems	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 Databases and Database Management System (DBMS), Characteristics of DBMS Approach, Advantages, Disadvantages & Applications of DBMS, Role of DBA, Data Integrity, Entity Integrity, Domain Integrity, Referential Integrity, Keys: Super key, candidate key, alternate key, Introduction to Transactions and Serializability, ACID properties.

Unit-II Three Schema Architecture of DBMS, Data Independence, Classifications of DBMS. Data Model, Types, Data Modelling Using E-R Diagram, Entity Types, Relationship Types, Role names & Recursive relationship, relationship degree, Attributes, Key attributes, Weak Entity, Owner Entity, Identifying relationship, Partial Key, Cardinality and Participation constraint, Characteristics of Hierarchical & Network Model.

Unit-III Relational Model Concepts, Conversion of ER Diagram to Relational Model, Relational Algebra- Select, Project, Cartesian Product, Joins, Division & Set operations, Aggregate Functions, Introduction to Tuple and Domain Relational Calculus, Functional dependency.

Unit-IV Design Guidelines for Relational Schemas, Normalisation, Types of Normal Forms, De-normalization. SQL: DDL, DML, DCL, Queries for Table Creation, Deletion and Modification in SQL, Defining Constraints, Select query for Data Extraction, group by, having, order by clauses, Insert, Delete & Update Statements in SQL, Views in SQL, types of Joins, Aggregate Functions, Nested Queries, Introduction of PL/SQL, Programming Constructs, Procedures, Functions, Exception handling, Cursors.

Books Recommended:

1. Elmasri, Navathe, *Fundamentals of Database Systems*, Pearson Education, 2008.
2. Henry F. Korth, Abraham Silberschatz, S. Sudurshan,*Database System Concepts*, McGraw-Hill, 2005.
3. C. J. Date, *An Introduction to Database Systems*, Pearson, 2006.
4. Ramakrishna, Gehrke, *Database Management Systems,* Mcgraw-Hill, 2014.
5. S. K. Singh, *Database Systems Concepts, Design and Applications*, Pearson, 2011.
6. Jeffrey D. Ullman, Jennifer Widom, *A first course in Database Systems*, Pearson, 2014.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – III

MST-3.4	Integral Transforms and Boundary Valued Problems	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I **Laplace Transform:** Laplace of some standard functions, Existence conditions for the Laplace Transform, Shifting theorems, Laplace transform of derivatives and integrals, Inverse Laplace transform and their properties, Convolution theorem, Initial and final value theorem, Laplace transform of periodic functions, Heaviside unit step function and Dirac delta function, Finite Laplace Transform: Definition and properties, Shifting and scaling theorem

Unit-II **Fourier Transforms:** Fourier integrals, Fourier sine and cosine integrals, Complex form of Fourier integral representation, Fourier transform, Fourier transform of derivatives and integrals, Fourier sine and cosine transforms and their properties, Convolution theorem.

Unit-III **Hankel Transform:** Basic properties of Hankel Transform, Hankel Transform of derivatives. Mellin Transform: Definition and properties of Mellin transform, Shifting and scaling properties, Mellin transforms of derivatives and integrals, Applications of Mellin transform.

Unit-IV Applications of Laplace transform to solve ODEs and PDEs. Application of Fourier transforms to Boundary Value Problems, Application of Hankel transform to PDE.

Books Recommended:

1. E. Kreyszig, *Advanced Engineering Mathematics*, John Wiley & Sons, 2011.
2. R.K. Jain and S.R.K. Iyenger, *Advanced Engineering Mathematics*, Narosa Publishing House, 2009.
3. F. B. Hildebrand, *Methods of Applied Mathematics*, Courier Dover Publications, 1992.
4. L. Debanth and D. Bhatt, *Integral Transforms and Their Applications*, 2nd Ed., Taylor and Francis Group, 2007.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – III

MST-3.5 SE	Object Oriented Programming using Java (Skill Enhancement)	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	3 + 1	3L + 2P

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*, 2nd Edition, Wiley India, 2006.
2. Bruce Eckel, *Thinking in Java*, Pearson Education, 2006.
3. H. Schildt, *Java 2: The Complete Reference* (5th ed.), Tata McGraw Hill, 2002.
4. Richard Johnson, *An Introduction to Java Programming and Object-Oriented Application Development*, Thomson Learning, 2006.
5. Deitel & Deitel, *Java-How to Program* (7th ed.), Prentice Hall, 2007.
6. Daniel Liang, *Introduction to Java Programming* (5th ed.), Prentice Hall, 2011.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – IV

MST- 4.1	Functional Analysis	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, subspaces, some concrete examples of Banach spaces, bounded linear operators, spaces of bounded linear operators, equivalent norms, open mapping and closed graph theorems and their consequences, uniform boundedness principle.

Unit-II Examples and basic properties, Forms of dual spaces, Hahm-Banach theorem and its consequences, Embedding and reflexivity, Adjoint of bounded linear operators, Weak convergence.

Unit-III Definitions and examples, Orthogonality of vectors, Orthogonal complements and projection theorem, Orthonormal sets, Complete orthonormal sets.

Unit-IV Bounded linear functionals, Riesz-Frechet theorem, Hilbert-adjoint operators, Self-adjoint operators, Normal operators and unitary operators.

Books Recommended:

1. E. Kreyszig, *Introductory Functional Analysis and Applications*, John-Wiley & Sons, 2006.
2. A.H.Siddiqi, Khalil Ahmad and P. Manchanda, *Introduction to Functional Analysis with Applications*, Anamaya Publishers, New Delhi and Anshan Ltd., U.K., 2006.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – IV

MST- 4.2	Complex Analysis	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Complex integration, Cauchy-Goursat Theorem, Cauchyôs integral formula. Higher order derivatives, Moreraôs theorem, Cauchy inequality and Liouvilleôs theorem, The fundamental theorem of algebra.

Unit-II Taylorôs theorem, Maximum modulus principle, Schwarz lemma, Laurentôs series, Isolated singularities, Residues, Cauchyôs residue theorem, Evaluation of integrals, Branches of many valued functions with arg z, log z, and z^a .

Unit-III Meromorphic functions, The argument principle, Roucheôs theorem, Inverse function theorem.

Unit-IV Bilinear transformations and their properties and classification, Definition and examples of conformal mappings.

Books Recommended:

1. B. Choudhary, *Elements of Complex Analysis*, Wiley Eastern Ltd., New Delhi, 1993.
2. J.B. Conway, *Functions of one Complex variable*, Springer-Verlag, International Student-Edition, Narosa Publishing House, 1980.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – IV

MST- 4.3	Formal Languages and Automata Theory	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Definitions - Alphabets, Strings, Languages, Grammar, automata and other related definitions, various operations on languages - union, concatenation, negation, reverse, kleen star, intersection etc. Applications of automata in various fields of Computer Science, Engineering and Application. Formal languages and grammars, Construction of grammar for a given language, finding language for a given grammar. Leftmost derivation, rightmost derivations, sentential forms, derivation tree/ parse tree, Ambiguous grammar and languages, Chomsky Classification of grammar and languages, unrestricted grammar, context sensitive grammar, Context free grammar, Regular Grammar , Right Linear grammar, left linear grammar hierarchy and machines corresponding to formal languages.

Unit-II Definition - DFA, NFA, Moore machine, Mealy machine, Regular Expression. Acceptance of a language by DFA and NFA, configuration of DFA NFA, Constructing DFA for a given language, finding language for a given DFA. Constructing NDFA for a given language, finding language for a given NFA. Converting NFA to DFA, Minimization of DFA, Finding a DFA/NFA from a given Regular Expression, identities on regular expression, Ardenôs theorem, Finding regular expression from a given DFA/NFA. Epsilon closure, Finding NFA with epsilon move from Regular expression, finding DFA from NFA with epsilon move. Methods to decide whether a given language is regular or not, Kleenôs theorem. Closure properties of regular languages. Pumping lemma for regular languages and its applications. Conversion from Mealy to moore machine and vice- versa. Algorithms based on FA.

Unit-III Simplification of Context free grammar, elimination of useless symbols, epsilon production and unit production, Normal forms of CFG:- CNF, GNF , converting a given grammar to CNF, converting a given grammar to GNF. Application of CFG, parsing and ambiguity, removing ambiguity from grammar. PDA- definition and construction. Acceptance by a PDA, Constructing PDA for a given language/grammar, Constructing language/grammar from a given PDA, Closure properties of Context free Languages. Pumping lemma for Context free languages and its application. Algorithms based on PDA.

Unit-IV Turing Machine - definition, construction and its applications, equivalence between TM and unrestricted grammar, TM as language acceptor, language decider and function computer, constructing TM for accepting/deciding a given language, constructing TM for computing a given function, Turing computable Functions, Combining TMs, Copying machine, shifting machine, TM for addition , multiplication, subtraction, division etc. Problems based on these concepts, Universal Turing Machine, halting problem, PCP problem, Context sensitive language and LBA

Books Recommended:

1. J. E. Hopcroft and J. D. Ullman and Rajeev Motwani, *Introduction to Automata Theory, Languages and Computation*, Pearson Education Asia, 3rd Edition, 2006.
2. H. R. Lewis, *Elements of the Theory of Computation*, Prentice Hall India Learning Private Limited, 2nd Edition, 2015.
3. J. Martin, *Introduction to languages and the Theory of Computation*, Third Edition, Mc-Graw Hill, 2007.
4. Peter Linz, *Introduction Formal Languages and Automata*, Narosa, 2010.
5. M. Chandrasekaran, and K.L.P. Mishra, *Theory of Computer Science: Automata, Language and Computation*, Prentice Hall of India, 2006.
6. D. C. Kozen, *Automata and Computability*, Springer (India) Pvt. Limited, 2007.
7. Kamala Krithivasan, *Introduction to Formal Languages, Automata Theory and Computation*, Pearson education, 2009.
8. Thomas A. Sudkamp, *An Introduction to the Theory of Computer Science Languages and Machines*, Pearson Education, 2005.
9. Alfred V. Aho and Jeffrey D. Ullman, *Principles of Compiler Design*, Narosa Publishing House, 2002.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – IV

MST- 4.4	Software Engineering	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Definition, Program Vs Software, Overview of S/W Engineering Process, Software life cycle Models: Build and Fix, Waterfall, Prototype, Iterative Enhancement Model, Evolutionary, Spiral Model, RAD Model.

Unit-II Requirements Engineering Process, Requirements Elicitation & Analysis Techniques, Problem Analysis, Data Flow Diagrams, Data Dictionaries, Software Requirement and Specifications (SRS), Characteristics of good quality SRS, Components of SRS - Functional & Non-Functional Requirements, Requirements Validation, Use Cases, Decision Table, Decision Tree.

Unit-III Software Project Planning Objectives, Project Size Estimation, Cost Estimation - COCOMO Estimation Model. Software Risks, Risk Identification, Risk Refinement, Risk Monitoring & Management. Introduction to Software Design, Principles, Abstraction, Modularity, Information Hiding, Functional Independence, Module Level Concepts: Cohesion, Coupling, Types of Cohesion and Coupling.

Unit-IV Design components - Data Design, Architectural Design, User Interface Design, Component Design, Activity Diagrams. Introduction to Software Testing, Error, Faults, Failure, Software Reliability, Functional and Structural Testing, Basis Path Testing, Cyclomatic complexity, Testing Levels: Unit, Integration, Validation and System Testing, Alpha and Beta Testing, Quality Assurance.

Books Recommended:

1. R.S. Pressman, *Software Engineering: A Practitioner's Approach*, McGraw-Hill, 2014.
2. Pankaj Jalote, *An Integrated Approach to Software Engineering*, Narosa Publishing, 2015.
3. K. K. Aggarwal and Yogesh Singh, *Software Engineering*, New Age International Publishers, 2008.
4. W. S. Jawadekar, *Software Engineering: Principles and Practice*, McGraw-Hill, 2004.
5. Douglas Bell, *Software Engineering for Students*, Addison-Wesley, 2007.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – IV

MST- 4.5 SE	Internet Technologies (Skill Enhancement)	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	3 + 1	3L + 2P

Unit-I Overview of Internet, History, World Wide Web, Web System Architecture, Internet vs. Intranet, Uniform Resource Locator, Protocol used in Internet ï TCP/IP, SMTP, PPP,HTTP(s), Services on the Internet: E-mail, Usenet, FTP, Search Engines, Web Browsers, Overview of Web authoring tools ï HTML 5.0, JavaScript.

Unit-II Java Database Connectivity ï Different Types of Drivers, JDBC APIôs, Establishing a Connection; Statements & its Type, ResultSet, Scrollable and Updatable ResultSet, Transactions Processing with Database; Metadata, SQLException. Overview of XML, XML Development Goal, Structure of XML Document, XML Parsers ï DOM and SAX.

Unit-III Servlet API Overview, Servlet Life Cycle, Servlet Implementation, Servlet Configuration, Servlet Exception, Requests & Responses, Deployment Descriptor, Servlets & JDBC, Session Tracking ï Cookies, URL Rewriting, Java Session APIs; Context and Collaboration.

Unit-IV JSP Tags - Directives, Scripting Elements, Standard Actions, Implicit Objects, Scope, JSP with Beans, JSP & Databases, Creating Custom JSP Tag Libraries using Nested Tags, working with session objects. EJB Basics ï EJB Container, EJB Classes, EJB Interfaces, Session Bean, Entity Bean & Message-Driven Bean.

Books Recommended:

1. Robert W. Sebesta, *Programming the World Wide Web*, (4th ed.), Addison Wesley, 2007.
2. H. Schildt, *Java 2: The Complete Reference* (7th ed.), Tata McGraw Hill, 2006.
3. Bruce Eckel, *Thinking in Java*, Pearson Education, 2006
4. Jim Keogh, *J2EE: The Complete Reference*, TMH, 2015.
5. Wrox Press, *Professional JSP/J2EE 1.3 Edition*, Shroff Publishers, 2005.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – V

MST- 5.1	Curves, Surfaces 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 Curves in R^3 , Unit speed curves, Tangent to a curve, Principal vectors, Binormal vector, Curvature and torsion, Serret - Frenet formula, Helix, Offset curves, Bertrand Curves.

Unit-II Surface in R^3, Smooth surface, Tangent , Normal and orientibilty, First fundamental form, Conformal mapping of a surface, Second fundamental form, Normal curvature, Geodesic, Curvature of curves on a surface.

Unit-III Principal curvature, Meusnierôs theorem, Eulerôs theorem, Umbilical surface, Guassian and mean curvature, Geodesic, Geodesic equation, Guass equations, Codazzi- Mainardi equations.

Unit-IV Bezier curves, Properties of Bezier curves, Join of two Bezier curves, subdivision of Bezier curves, Linear, quadratic and cubic Bezier curves, Derivative of Bezier curve, B-spline curves, Derivatives and properties of B-spline curves, B-spline surfaces.

Books Recommended:

1. B.O. Neill, *Elementary Differential Geometry*, Academic Publishers, 2006.
2. Andrew Pressley, *Elementary Differential Geometry*, Springer, 2010.
3. M. P. doCarmo, *Differential Geometry of Curves and Surfaces*, Prentice Hall, 1976.
4. M. Ganesh, *Basics of Computer Aided Geometric Design: An Algorithmic Approach*, 2nd Revised Edition, I. K. International, 2011.
5. T. G. Willmore, *Introduction to Differential Geometry*, Oxford University Press, 1964.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – V

MST- 5.2	Analysis and Design of Algorithms	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 Algorithm Design Paradigms, Motivation, Concepts of Algorithmic, Efficiency, Run-Time Analysis of Algorithms, Order Notation ï Big O, Theta and Omega Notations, Substitution, Iteration and Masterôs Methods.

Unit-II Sorting and Searching Techniques: Insertion Sort, Quick Sort, Merge Sort, Heap Sort; Linear Time Sorting: Bucket Sort, Radix Sort and Counting Sort, Searching Techniques: Sequential Search, Binary Search, Multiplication of Large Integers and Strassenôs Matrix Multiplication.

Unit-III Advanced Data Structures: Heaps and Priority Queues, Ordered Binary Trees, AVL Trees, B-Trees, B+ Trees, Binomial Heaps, Red-Black Trees, Topological Sorting. Algorithm Design Strategies: Divide-and-Conquer Approach, Structure of Divide-and-Conquer Algorithms, Analysis of Divide-and-Conquer Algorithms. Greedy Technique - Overall View of Greedy Paradigm, Primôs Algorithm, Kruskalôs algorithm, Dijkstraôs Algorithm.

Unit-IV Dynamic Programming: Form of Dynamic Programming Algorithms, Differences between Dynamic Programming and Divide-and-Conquer Approach, Matrix Chain Multiplication, Longest Common Subsequence Problem, Warshallôs and Floydôs Algorithms. NP - Completeness: O/1 Knapsack Problem, Travelling Sales Person Problem, Polynomial Time, Polynomial Time Verification, NP Hard and NP-Complete Problems, Simple NP-Hard Problems.

Books Recommended:

1. Cormen Leiserson, Rivest and Stein, *Introduction to Algorithms*, PHI.
2. A. Levitin, *Introduction to the Design and Analysis of Algorithms*, Pearson Education.
3. Aho, Hopcroft & Ullman, *Design and Analysis of Algorithms*, Pearson Education.
4. Sar Baase, Gelder, *Computer Algorithms: Introduction to Design and Analysis*, Pearson Education, 1999.

M. Sc. Tech. Industrial Mathematics with Computer Applications, Semester – V

MST- 5.3	Data Mining	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 Data Mining: KDD (Knowledge Discover from Databases) Process and Data Mining; KDD Steps; Types of Data for Data Mining, Data Mining Functionalities, Classification of Data Mining Systems; Data Mining Task Primitives; Major Issues in Data Mining. Introduction to Data Preprocessing, Descriptive Data Summarization: Measuring and Central Tendency and Dispersion of Data; Visualization of Descriptive Data Summaries; Data Cleaning: Handling Missing Values, Filtering Noisy Data ï Binning Method; Data Integration; Data Transformation: Smoothing, Aggregation, Generalization, Normalization and Feature Selection; Data Reduction; Data Discretization and Concept Hierarchy Generation.

Unit-II Association Rule Mining: Market basket Analysis; Frequent Itemsets, Closed Itemsets, and Association Rules; Support and Confidence; Apriori Algorithm for Mining Frequent Itemsets using Candidate Generation; Generating Association Rules from Frequent Itemsets; Improving the Efficiency of Apriori Algorithm; FP-Growth Algorithm for Mining Frequent Itemsets without Candidate Generation; Mining Closed Frequent Itemsets; Correlation Analysis.

Unit-III Classification Rule Mining: Introduction to Classification and Prediction; Classification by Decision Induction; Attribute Selection Measures: Information Gain, Gain Ratio, and Gini Index; Tree Pruning; Bayesian Classification: Bayesô Theorem, Naïve Bayesian Classification, Bayesian Belief Networks; Classifier Accuracy Measures: Sensitivity, Specificity, Precision, and Accuracy; Predictor Error Measures; Accuracy Evaluation Methods: Holdout, Random Subsampling, Cross-validation, and Bootstrap; Accuracy Enhancement Methods: Bagging and Boosting.

Unit-IV Introduction to Clustering, Features Required for Clustering Algorithms, Data Types and Dissimilarity Measures in Cluster Analysis; Categorization of Clustering Methods; Partitioning-Based Clustering: k-means Algorithms, k-medoids algorithms (PAM, CLARA, CLARANS); Hierarchical Clustering: Agglomerative and Divisive Methods (AGNES, DIANA, BIRCH; Density-Based Clustering: DBSCAN.

Books Recommended:

1. J. Han & M. Kamber, *Data Mining Concepts and Techniques*, 2nd Ed., Morgan Kaufman, 2011.
2. Witten & E. Frank, *Data Mining – Practical Machine Learning Tools and Techniques*, Morgan Kaufman, 2011.
3. Michael Berry & Gordon Linoff, *Data Mining Techniques*, 3rd Edition, 2011.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – V

MST- 5.4	Artificial Intelligence	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	4	4

Unit-I Introduction: AI Problems, Foundation of AI and History of AI Intelligent Agents: Agents and Environments, The Concept of Rationality, The Nature of Environments, Structure of Agents, Problem Solving Agents and Problem Formulation, Searching: Searching For Solutions, Uniformed Search Strategies ï Breadth First Search, Depth First Search, Depth Limited Search, Iterative-Deepening Depth First Search Bi-Direction Search - Comparison. Search with Partial Information (Heuristic Search) Greedy Best First Search, A* Search, Memory Bounded Heuristic Search, Heuristic Functions, Local Search Algorithms: Hill Climbing, Simulated, Annealing Search, Local Beam Search, Genetical Algorithms. Constrain Satisfaction Problems: Backtracking Search for CSPS Local Search for Constraint Satisfaction Problems.

Unit-II Knowledge Representation & Reasons Logical Agents: Knowledge ï Based Agents, the Wumpus World, Logic, Propositional Logic, Resolution Patterns in Propos Ional Logic, Resolution, Forward & Backward. Chaining. First Order Logic. Inference in First Order Logic, Propositional Vs. First Order Inference, Unification & Lifts Forward Chaining, Backward Chaining, Resolution.

Unit-III Planning: Classical Planning Problem, Language of Planning Problems, Expressiveness and Extension, Planning With State ï Space Search, Forward States Spare Search, Backward States Space Search, Heuristics for Stats Space Search. Planning Search, Planning With State Space Search, Partial Order Planning Graphs.

Unit-IV Learning: Forms of Learning, Induction Learning, Learning Decision Tree, Statistical Learning Methods, Learning With Complex Data, Learning With Hidden Variables ï The EM Algorithm, Instance Based Learning, Neural Networks.

Books Recommended:

1. Rajendra Akerkar, *Introduction to Artificial Intelligence*, PHI, 2005.
2. Stuart Russel/Peter Norvig, *Artificial Intelligence – A Modern Approach*, 2nd Edition, PHI/Pearson Education, 2015/2013.
3. Patrick Henry Winston, *Artificial Intelligence*, 3rd Edition, Pearson Edition, 2002.
4. E. Rich and K. Knight, *Artificial Intelligence*, 3rd Edition, TMH, 2008.
5. Patterson, *Introduction to Artificial Intelligence and Expert Systems*, PHI, 1997.
6. Giarrantana, *Expert Systems: Principles and Programming,* Cengage Learning, 2007.
7. Ivan Bratka*, PROLOG Programming for Artificial Intelligence,* Pearson Education, 2008.

M.Sc. Tech. Industrial Mathematics with Computer Applications, Semester – V

MST- 5.5 AE	Computer Graphics (Ability Enhancement)	Unit	Credit	Lecture/ week
Internal Assessment: 25 Marks End Semester Examination: 75 Marks Duration of Examination: 2 Hrs.		4	3+1	3L + 2P

Unit-I Introduction of Computer Graphics and its Application; Overview of Computer Graphics; Video Display Devices; Raster Scan Display; Random Scan Display; Cathode Rays Tube (CRT) Display Device; Direct View Storage Tube (DVST) Display Device; Flat Panel display: Plasma Panel Display, Thin Film Electroluminescent Display, Light Emitted Diode (LED) Display Device, Liquid Crystal Display Device; Color CRT Display Devices: Beam-Penetration Method, Shadow-Mask Method. Algorithms: Line Drawing Algorithm: Digital Differential Analyzer (DDA) line drawing algorithm, Bresenham Line Drawing Algorithm; Circle Generating Algorithm: Properties of Circles, Mid-point Circle Algorithm; DDA Circle generating Algorithm, Bresenhamôs Circle generating Algorithm, Ellipse Generating Algorithm: Properties of Ellipse, Mid-point Ellipse Algorithm; Polygon Fill Algorithm: Scan-Line Polygon Fill Algorithm, Boundary Fill Algorithm, Flood Fill Algorithm. Curve and Surface: Spline Representation, Cubic Spline, Bezier Curve, B Spline Curve, Bezier Surface.

Unit-II Two Dimensional Geometric Transformation: Basic Transformations: Translation, Rotation, Scaling; Matrix Representation; Homogeneous Coordinates; Composite Transformations: Translations, Scalings, General Pivot-Point Rotation, General Fixed-Point Scaling, General Composite Transformations and Computational Efficiency; Other Transformations: Reflection, Reflection about x-axis, Reflection about y-axis, Reflection about a Line Perpendicular to xy-Plane and Passes Through Origin, Reflection about a General Line in xy-Plane, Shearing Operations; Transformation between Cartesian Coordinate Systems.

Unit-III Two Dimensional Viewing and Clipping: Viewing: The viewing Pipeline, Viewing Coordinate Reference Frame, Window to Viewport Coordinate Transformation; Clipping: Point clipping; Line Clipping; Cohen-Sutherland Line Clipping Algorithm, Midpoint Subdivision Line Clipping Algorithm, Liang-Barsky Line Clipping Algorithm, Liang-Barsky Line Clipping Algorithm to Clip a Line Against Non-Rectangular Convex Polygon, Splitting Concave Polygon into Convex Polygons, Liang-Barsky Line Clipping Algorithm to Clip a Line Against Concave Polygon; Polygon Clipping: Sutheland-Hodgeman Polygon Clipping, Weiler-Atherton Polygon Clipping; Text clipping.

Unit-IV Three Dimensional Geometric: Basic Transformations: Translation, Rotation, Rotation with Rotation Axis Parallel to one of the Principal Axis, General Rotation, Scaling; Other Transformations: Reflections, Shears; Projection: Types of Projections, Perspective Projection Transformation with Center at Origin, Perspective Projection Transformations with center at $C_0(a, b, c)$, Orthographic Projection Transformation with Projection Plane as one of the Standard Plane, Orthographic Projection Transformation with Projection Plane Passes Through $R_0(x_0, y_0, z_0)$ and Normal Vector is $N=n_1i+n_2j+n_3k$, Isometric Projection Transformation; Three Dimensional Line Clipping: Mid-Point Subdivision Line Clipping Algorithm, Liang-Barsky Line Clipping Algorithms, Hidden Surface Detection: Z-Buffer Method, A-Buffer Method, Scan Line Method.

Books Recommended:

1. Donald Hearn & M. Pauline Baker, *Computer Graphics*, 2nd Edition, Pearson Education, 1996.
2. David F. Roger, *Procedural Element for Computer Graphics*, Tata Mc Graw Hill, 2001.
3. David F. Roger & J. Alan, *Mathematical Element for Computer Graphics*, Mc Graw Hill Education, 2002.