M.Sc. Mathematics with Computer Science

Syllabus

Department of Mathematics
Jamia Millia Islamia

COURSE STRUCTURE

Semester-wise course structure is described in the following tables:

First Semester

Paper No.	Title of the Paper	Total Marks
MTM101	Real Analysis	100
MTM102	Abstract Algebra	100
MTM103	Discrete Mathematical Structures	100
MTM104	Computing Fundamentals & Programming	100
MTM105	Computer Based Numerical Methods	100
Lab-I	Programming in C	50
Lab-II	Numerical Methods	50
	Total = 600	

Second Semester

Paper No.	Title of the Paper	Total Marks
MTM201	Topology	100
MTM202	Linear Algebra	100
MTM203	Differential Equations & Applications	100
MTM204	Data Structure	100
MTM205	Operating Systems	100
Lab-III	Data Structure using C	50
Lab-IV	UNIX / LINUX Shell Programming	50
	Total = 600	

Third Semester

Paper No.	Title of the Paper	Total Marks
MTM301	Functional Analysis	100
MTM302	Mechanics	100
MTM303	Differential Geometry	100
MTM304	Object Oriented Programming	100
MTM305	Database Management System	100
Lab-V	Programming in Java	50
Lab-VI	Oracle	50
		Total = 600

Fourth Semester

Paper No.	Title of the Paper	Total Marks
MTM401	Complex Analysis	100
MTM402	Fluid Dynamics	100
MTM403	Differentiable Manifolds	100
MTM404	Wavelet Analysis	100
MTM405	Software Engineering	100
Lab-VII	Mini Project	100
	Viva Voce	100
		Total = 700

DETAILED SYLLABUS

Code	Name	Lecture
MTM101	**Real Analysis**	4

Unit 1. Countability of sets. 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 2. Measurable function, Characteristic function, Step function, Continuous function, Set of measure zero, Borel measurable function, The structure of measurable function.

Unit 3. Riemann integral and its deficiency, Lebesgue integral of bounded function, Comparision of Riemann and Lebesgue integerals, Properties of Lebesgue integral for bounded measurable function, The Lebesgue integeral for unbounded functions, Integral of non-negative measurable functions, General Lebesgue integeral, Improper integral.

Unit 4. 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 domainated 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.

References

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)

Code	Name	Lecture
MTM102	**Abstract Algebra**	4

1. Group Theory

Unit-I: Groups, Subgroups, Normal Subgroups, Quotient Groups, Right Cosets, Homomorphism, Kernel of Homomorphism, Isomorphism, Fundamental theorem of Homomorphism.

Unit-II: Order of an element of a group, Lagrange's Theorem for finite groups, Normalization of an element, Centre of a group, Conjugate class, Class Equation and its applications, Sylow Theorem.

2. Ring Theory

Unit-III: Ring, Subring, Ideal, Integral domain and their Properties, Ring Homomorphism, Isomorphism, Quotient Ring, Euclidian Ring, Rings of Polynomial and their properties.

Unit-IV: Unique Factorization Domain, Unique Factorization Theorem, Primitive Polynomials, Gauss lemma, Eienstein Criteria for Irreducibility.

References

- I. N. Herstein, Topics in Algebra.
- Surjeet Singh & Q Zameeruddin, Modern Algebra.
- D.A.R. Wallace, Group, Rings and Fields.

Code	Name	Lecture
MTM103	**Discrete Mathematical Structures**	4

Unit 1. Relations and Functions, Equivalence Relations, Partial Order, Recurrence Relations, Solutions of Linear homogeneous Recurrence Relations, Introduction to Mathematical Logic, Propositional Calculus.

Unit 2. Lattices and Boolean algebra, Boolean Functions, Connonical Form (Disjunctive Normal Form) of a Boolean function, Karnaugh Maps.

Unit 3. Graphs and their representations, Walk, Path, Cycle, Circuit, Eulerian Graphs, Connected Graphs, Planar Graphs, Trees, Spanning trees, Binary Tree Traversals.

Unit 4. Linear codes, Hamming Code, Generator and parity check matrix, Hamming distance standard array and Syndrome decoding, introduction to cyclic codes.

References

1. Discrete Mathematics
   K.A. Ross, Charles R.W. Wright,
   Prentice Hall Inc.

2. Discrete Mathematical Structure for Computer Sciences
   Bernard Kolman / Robert C. Busby
   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.

Code	Name	Lecture
MTM104	**Computing Fundamentals & Programming**	4

Computer Fundamentals: Introduction, Computer Architecture, Program, Software, Types of Software, Problem Solving, Top-down Design, Implementation of Algorithms, Flow Chart.

Basic Concepts of C: Introduction to C, Features, Character Set, C Token, Identifier & Keyword, Constants, Variables, Data Types in C , Integer, Floating Point, Character, String, Enumeration, ,Data Declaration & Definition, Operator & Expression Arithmetic, Relational, Logical, Increment & Decrement, Bit wise, Assignment, Conditional, Precedence & Associability of Operators. Managing Console I/O, Control Statements, Selection Statements, If, Nested if, if-else-if, The Alternative, The Conditional Expression, Switch, Nested Switch, Iteration Statements for loop, while loop, do-while loop ,Jump Statements.

Functions: Introduction, Need for User-Defined Function, A Multi-function Program, Definition of Function, Arguments & local variables, Returning and Calling Function by reference & Call by value, Passing Arrays & Strings to Function, Returning Multiple Values, Recursion, Recursive Functions, Storage Class & Scope.

Arrays, Strings & Pointers: Single Dimension Arrays, Accessing array elements, Initializing an array, Multidimensional Arrays Initializing the arrays, Memory Representation Accessing array elements, Passing Single Dimension array to Function, Array & Pointer, Array of Pointers, String Manipulation Functions, The Pointer operator, Pointer Expression, Declaration of Pointer, Initializing Pointer, De-referencing Pointer, Pointer to Pointer, Constant Pointer, Array of Pointers, Pointer to Function.

Structure, Union, Enumeration & File Handling: Structures, Declaration and Initializing Structure, Accessing Structure members, Structure, Assignments, Arrays of Structure, Passing Structure to function, Structure Pointer, Unions, File handling, Introduction, Defining & Opening a File, Closing a File, Input/Output Operations on Files, Command Line Arguments.

Reference:

- E Balagruswamy, Programming in ANSI C, TMH, Third Edition 2005
- R G Dromey, How to Solve by Computer, Pearson Education, Fifth Edition 2007.
- Deitel & Deitel, C: How to Program, Pearson Education, , Third Edition, 2003

Code	Name	Lecture
MTM105	**Computer Based Numerical Methods**	4

Unit-1 (6+6):

Solution of algebraic and transcendental equations by Newton-Raphson method for simple and multiple roots and its convergence. Solution of system of non-linear equations by Iteration and Newton-Raphson method. Lagrange's form of interpolating polynomial. Existence and uniqueness of interpolating polynomial, Piecewise interpolation, Hermite and Cubic spline interpolation.

Unit-2 (10)

Least square approximation : Weighted least square approximation. Method of least square for continuous functions, orthogonal polynomials, Gram-Schmidt orthogonalization process and approximation of functions using Chebyshev polynomials.

Unit-3 (6+6)

Numerical integration by Romberg method; Guassian quadrature formula and error estimation. Numerical solution of initial value problems: Runge Kutta method of order four for system of equations and for second and higher order differential equations. Boundary Value problems by Finite difference method and shooting method. Convergence of finite difference scheme.

Unit-4 (10)

Numerical solution of partial differential equations: Parabolic equations- finite difference approximation to partial diff. derivatives, explicit method 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.

Reference:

1. S.D. Conte & Carl D. Boor, Elementary Numerical Analysis

2. Iyengar and Jain: Numerical methods for Scientific and Engineering Computations
3. G.D. Smith, Numerical Solution of Partial Differential Equations
4. M.K. Jain, Numerical Solution of Differential Equations
5. Naseem Ahmad, Fundamentals Numerical Analysis with error estimation
6. Gerald & Wheatlay: Applied Numerical Analysis

Code	Name	Lecture
MTM201	Topology	4

Unit – 1:

Metric Spaces, Open and Closed spheres and sets. Topological Spaces. Closed set, Closure, Dense subsets, Neighborhoods, Interior, Exterior and Boundary of a set, Accumulation points and Derived sets, Bases and Sub bases, Subspaces and Relative topology. The Product topology on two spaces. The Metric topology. Continuous functions and Homeomorphism.

Unit – 2:

First and Second countable spaces, Separable spaces, Second countability and Separability, Separation Axioms, T_i (i = 0,1,2) spaces and their characterizations and basic properties, Regular and Normal Spaces, Urysohn's lemma, Tietze extension theorem.

Unit – 3:

Open covering and Compact spaces, Continuous functions and Compact sets, Finite intersection property, Locally compact spaces, Countable compactness and Sequential compactness, Bolzano Weierstrass property, Lebesgue covering lemma, Total boundedness, Equivalence of compactness.

Unit – 4:

Separation of a space, Connected spaces, Connected sets in the real line, Totally disconnected spaces, Intermediate value theorem, Path connected, Components, Local connectedness, Locally path connected spaces, Continuous functions and connected sets.

Books Recommended

1. J.R. Munkres: Topology (Relevant portions only)
   Pearson Education, 2004.
2. Benjamin T. Sims:
   Fundamentals of Topology (Relevant portions only)
   Macmillan Publishing Co. Inc. N.Y.

Help Books

1. Colin Adams and Robert Franzosa:
   Introduction to Topology Pure and Applied

Pearson Prentice Hall, 2009.

2. G.F. Simmons:
   Introduction to Topology and Modern Analysis
   McGraw Hill Book Company, 1963
3. B.K.Tyagi:
   Metric Spaces
   Cambridge University Press India Pvt. Ltd., 2010

Code	Name	Lecture
MTM202	**Linear Algebra**	4

Unit-I

Vector Space, Subspaces and properties, Quotient Space, Basis and Dimension, Linear Transformation, Rank And Nullity of a Linear Transformation, Sylvester's Law of Nullity.

Unit-II

Algebra of Linear Transformations, Hom(u,v), Dual Space, Bidual, Matrix of Linear Transformations, Change of Basis Equivalent and Similar Matrices, Dimension of Hom(u,v), Isomorphism between link of all linear Transformation on a Vector space and ring of all n x n matrices over F.

Unit-III

Minimal Polynomials, Invertible linear Transformation, Eigen Values, Eigen Vectors, Result on Minimal Polynomial related to Eigen Values and Eigen Vectors.

Unit-IV

More on Minimal Polynomials, Cyclic Space, Companion matrix, Jordan Blocks, Inner Product Space, Unitary, Adjoint, Hermition Adjoint, Skew Hermition, Normal Linear Operators.

References

- I. N. Herstein, Topics in Algebra.
- P. R. Halmos, Linear Algebra with Problems.
- Hoffman & Kunze, Linear Algebra.
- Surjeet Singh & Q Zameeruddin, Modern Algebra.

Code	Name	Lecture
MTM203	**Differential Equations and Applications**	4

Unit 1. 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 2. 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, Hypergeometric, Hermite and Lagurre differential equations.

Unit 3. Formulation of heat conduction equation and its solution by variable sepration method, Steadystate condition and the solution of heat conduction problem with non-zero end conditions, Formation of wave equation and the solution of wave equation.

Unit 4. 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.

References

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

Code	Name	Lecture
MTM204	**Data Structures**	4

Introduction to Data Structure: Definition of Data Structure, Types & Characteristics 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.

Arrays, Stacks and Queues: Characteristics & of an Array, Row and Column Major Implementations of 1 - D, 2-D, 3-D Arrays. Operations on Stack, Stack Implementation using Array and Linked List, Applications of Stack - Polish and Reverse Polish Notations, Recursion, Buddy Systems, Garbage Collection. Operations on Queues, Types of Queues: Linear Queue, Circular Queue, Priority Queue, Double Ended Queue, Queue Implementation.

Linked Lists: Concept of a Linked List, Linear Single and Double Lists, Circular Single and Double List, Operations on Linked Lists. Applications of Linked Lists.

Trees and Graphs: Concepts of a Tree, Definitions of n-ary, Binary Trees, Strictly Binary Tree, Complete Binary Tree, Almost Complete Binary Tree, Level of a Node, Height/Depth of a Tree. Operations on Tree, Tree Search Algorithms, Binary Search Tree, Tree Traversal Algorithms, AVL Trees - Balance of a Node, Weight Balanced Trees. Threaded Binary Tree, Trees Traversal, Huffman Algorithm, Definitions of Vertex Edge and Graph, Types of Graphs – Directed/Undirected, Connected/Disconnected, Cyclic/Acyclic, Representation of Graphs: Adjacency Matrix, Linked List. Graph Algorithm-Warshalls, BFS, DFS, Kuruskal, Prims.

Sorting and Searching: Bubble Sort, Sequential Sort, Selection Sort, Insertion Sort, Merge Sort, Quick Sort, Heap Sort. Linear Search and Binary Search

References:

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

Code	Name	Lecture
MTM205	**Operating Systems**	4

Introduction: Evolution of Operating System, Types and Functions of Operating Systems, Operating System Structure, Operating System Classification, Characteristics of Modern Operating Systems.

Processor Management: Process Overview, Process States and State Transition, Multiprogramming, Multi-Tasking, Levels of Schedulers and Scheduling Algorithms. Process Communication, Process Synchronization, Semaphores, Critical Section and Mutual Exclusion Problem, Classical Synchronization Problems, Characterization of a Deadlock, Deadlock Prevention, Deadlock Avoidance, Multithreading.

Memory Management: Classical Memory Management Techniques, Paging, Segmentation, Virtual Memory - Demand Paging, Page Replacement Policies, Allocation of Frames, Thrashing.

File Management and Mass-Storage Structure: File Concept, Access Methods, Directory Structure, File-System Mounting, File Sharing, Protection, File-system Structure, File-System Implementation, Directory Implementation, Allocation Methods. Free-Space Management, Efficiency and Performance, Recovery, Log-Structured File System NFS. Overview of Disk Scheduling - FCFS, SSTF, SCAN, C-SCAN, LOOK, C-LOOK, Disk Management.

References

- Silberschatz, P.B.Galvin and G. Gagne, **Operating System Concepts** (6th ed.), John Wiley & Sons, Inc., 200.
- A.S. Tanenbaum, **Modern Operating Systems** (2nd ed.), Prentice-Hall of India, 2001.
- William Stallings, **Operating Systems: Internals and Design Principles** (5th ed.), Prentice-Hall of India, 2006.
- Gary Nutt, **Operating Systems: A Modern Approach** (3rd ed.), Addison Wesley, 2004
- D.M. Dhamdhere, **Operating Systems: A Concept Based Approach** (2nd ed.), Tata McGraw-Hill, 2007
- Deitel Deitel Choffnes, **Operating Systems** (3 rd ed.), Pearson Education 2007.

Code	Name	Lecture
MTM301	**Functional Analysis**	4

Unit 1. Normed Spaces, Banach Spaces and Bounded Linear Operators:

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 2. Bounded Linear Functionals:

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 3. Inner Product and Hilbert Spaces:

Definitions and examples, orthogonality of vectors, orthogonal complements and projection theorem, orthonormal sets, complete orthonormal sets.

Unit 4. Functionals and Operators on Hilbert Spaces:

Bounded linear functionals, Riesz-Frechet theorem, Hilbert-adjoint operators, self-adjoint operators, normal operators and unitary operators.

Books Recommended:

1. Introductory Functional Analysis and Applications
   E. Kreyszig,
   John-Wiley & Sons.

2. Introduction to Functional Analysis with Applications
   A.H.Siddiqi, Khalil Ahmad and P. Manchanda,
   Anamaya Publishers, New Delhi and Anshan Ltd., U.K. (2006).

Code	Name	Lecture
MTM302	**Mechanics**	4

Unit-I. Kinematics of a rigid body motion, Moments and Products of inertia, Perpendicular and Parallel axis theorem, Momental ellipsoid, Kinetic energy, Theorem of Konig, Angular momentum.

Unit-II. Euler's dynamical equations, Euler's angles, motion of symmetrical top, compound pendulum.

Unit-III. Generalized coordinates, Lagrange's equations of motion, Lagrange function, Techniques of calculus of variations

Unit-IV. Hamilton's principles.Hamilton's equations of motion, Canonical transformation, Lagrange's and Poison brackets Integral in variances, Hamilton-Jacobi Poisson equations.

References

1. Synge and Griffith,Principle of Mechanics, McGraw Hill Company
2. Chorlton, F., Textbook of Dynamics.John Wiley & Sons
3. K. SankaraRao, Classical Mechanics, PHI India
4. Madhumagal Pal, A course on classical mechanics, Narosa Publication.
5. C. Fox, An introduction to the Calculus of Variation, Dover Publication
6. S.L. Loney, Ele. Treatise on the dynamics of particle and of rigid bodies,Forgotten Books.

Code	Name	Lecture
MTM303	**Differential Geometry**	4

Unit-I:

Co-ordinate transformation, Covariant, Contravariant and Mixed tensors, Tensors of higher rank, Symmetric and Skew-symmetric tensors, Tensor algebra, Contraction, Inner product, Riemannian metric tensor, Christoffel symbols, Covariant derivatives of tensors.

Unit-II:

Differentible curves in R3 and their parametric representations, Vector fields, Tangent vector, Principal normal, Binormal, Curvature and torsion, Serret-Frenet formula, Frame fields, Covariant differentiation, Connection forms, The structural equations.

Unit-III:

Surfaces, Differentiable functions on surfaces, Differential of a differentiable map, Differential forms, Normal vector fields, First fundamental form, Shape operator, Normal curvature, Principal curvatures, Gaussian curvature, Mean curvature, Second fundamental form.

Unit-IV:

Gauss equations, Weingarten equation, Codazzi-Mainardi equations, Totally umbilical surfaces, Minimal surfaces, Variations, First and second variations of arc length, Geodesic, Exponential map, Jacobi vector field, Index form of a geodesic.

References

1. Elementary Differential Geometry
   Barett O' Neill, Academic Press, 2006.

2. Differential Geometry of Curves and Surfaces
   Manfredo P. Do' Carmo, Prentice Hall Inc., New Jersey U.S.A. 1976.

3. Curves and Surfaces
   S. Montiel and A. Ros, American Mathematical Society, 2005.

4. Differential Geometry, A first course
   Somasundaram, Narosa Publication.

5 Tensor Calculus
   Zafar Ahsan, Anamaya Publications, New Delhi.

6. Tensor Calculus
U. C. De, Narosa Publications, New Delhi.

Code	Name	Lecture
MTM304	**Object Oriented Programming**	4

Object Oriented Methodology & Java Language Basics: Paradigms of Programming Languages, Evolution of OO Methodology, Basic Concepts of OO Approach, Comparison of Object Oriented and Procedure Oriented Approach, Benefits and Applications of OO Programming, Introduction to Common OO Languages, Introduction to Java, Basic Features of Java, Java Virtual Machine Concepts, Data type, Variables and Arrays, Operators, Control Statements.

Object Oriented Concepts: Classes and Objects, Constructors, Method Overloading, Argument Passing, Recursion, Access Control, Understanding Static. Inheritance and Polymorphism – Inheritance Basics, Access Control, Use of Super, Multilevel Inheritance, Method Overriding, Dynamic Method Dispatching, Preventing Inheritance and Overriding.

Packages, Interface and Exception Handling: Java API Package, Using System Packages, Naming Conventions, Creating Packages, Accessing a Package, Using a Package, Adding a Class to a Package. Interface – Defining an Interface, Implementing Interface, Applying Interface, Accession of Interface Variable, Interface and Abstract Class. Exception Handling - Exception Types, Handling of Exception using try-catch, Catching Multiple Exceptions, Nested try Statements, Use of throw, throws and finally Clause, Java Built-in Exception, Creating Exception Subclasses.

Multithreading, I/O and String Handling: Thread Models, Main Thread, Creating Threads, Thread Priorities, Life Cycle of Thread, Synchronization in Java, Thread Exceptions, Inter-Thread Communications. I/O Basics, Byte Stream and Character Stream Classes, Reading from and Writing to Console, Reading and Writing Files, Transient and Volatile Modifiers, Stream Tokenizer, Serialization. String – Fundamental of Characters and Strings, String Class, String Operations, String Buffer Class and Methods.

Applet Programming and Advance java Concepts: Applet Basics, Applet Architecture, Applet Initialization and Termination, Writing Applets, HTML Applet Tags, Passing Parameters to Applets, AudioClip Interface, and AppletStub interface. Java Database Connectivity – Different Types of Drivers, Establishing a Connection, Transactions with Database. Overview of Event Handling, AWT Controls, Layout Managers, Menus and Swing.

References

1. Cay Horstmann, **Computing Concepts with Java Essentials** (5th ed.), John Wiley & Sons, 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. Cay S. Horstmann & Gary Cornell, **Core Java Volume I** (7th ed.), Sun Microsystems Press Java Series, 2006
6. Deitel & Deitel, **Java-How to Program** (7th ed.), Prentice Hall, 2006
7. Daniel Liang, **Introduction to Java Programming** (5th ed.), Prentice Hall, 2005
8. J.A. Slack, **Programming and Problem Solving with Java**, Thomson Learning, 1999

Code	Name	Lecture
MTM305	**Database Management Systems**	4

Unit 1. Databases, DBMS, Advantages of DBMS, Role of DBA, data integrity, data independence.

Unit 2. Architecture of Database Management System: External level, conceptual level and internal level, Schemas, Distributed databases.

Unit 3. Three approaches to DBMS, Characteristics of Hierarchical model, DBTG Network Model, Introduction to Relational model, Security and Reliability, Audit trail.

Unit 4. Normalization, First Normal Form, Second Normal Form, Third Normal Form, BCNF, Relational Algebra and Relational Calculus, Well formed formula, SQL Language.

References:-

1. An Introduction to Database System
   C.J. Date, Sixth Ed.,
   Addison-Wesley Publishing Co.

2. Principles of Database System
   Ullman, Jeffery D.,
   Galgotia Publications (P) Ltd.

Code	Name	Lecture
MTM401	**Complex Analysis**	4

Unit-I

Representation of Complex Numbers, Analytic Function, Cauchy Riemann Equations, Power Series, Some Elementary Functions, Harmonic Functions.

Unit-II

Properties of Line Integrals, Zeros of an Analytic Function, Cauchy's Theorem, Morera's Theorem, Cauchy's Integral Formula, Cauchy's Inequality, Fundamental Theorem of Algebra, Poisson's Formula, Liouville's Theorem, Rouche's Theorem, The Argument Principle.

Unit-III

Zeros and Poles, Classification of Isolated Singularities, Taylor's and Laurent's Series, Winding Numbers and Residues, Cauchy Residue Theorem and Application in Evaluation of Improper Real Integrals and Evaluation of Sum.

Unit-IV

Conformal Mapping Properties, Schwarg Lemma, Riemann Mapping Theorem (Without Proof), Maximum Modulus Theorem, Analytical Continuation.

References

- Rudin, Real and Complex Analysis
- J. B. Conway, Complex Analysis.
- Alfors, Complex Analysis.
- E. C. Titchmarsh, Complex Analysis.
- B. Choudhary, Complex Analysis.
- Anant R. Shastri – Complex analysis
- Zill Dennis G. & Shanahan Patrick D. – A first course in Complex Analysis with Applications.
- Fundamentals of Complex Analysis with Applications to Engineering and Science, E-B Saff and A-D Snider.

Code	Name	Lecture
MTM402	**Fluid Dynamics**	4

Unit - 1. Ideal and Real fluids, Pressure, Density, Viscosity, Description of Fluid motion, o-Lagrangian method, Eulerian method. Steady and unsteady flows, Uniform and nonuniform flows, One dimensional, two dimensional and axisymmetric flows, Line of flows, Stream line Path line, Stream surface, Stream tube, Streak lines, Local and Material delivative, Equation of Continuity.

Unit-2. Euler's equation of Motion along a stream line, Equation of motion of an inviscid fluid, conservative field of force, Integral of Eulers equation, Bernoullis equation and its applications, flow from a tank through a small orifice, Cauchys integral, Symmetric forms of the equation of continuity, Impulsive motion of a fluid, Energy equation.

Unit -3. Dimenssional Analysis, Buckinghm's pi theorem, Variable in fluid mechanics, Procidures of dimensional Analysis, Similitude, Important dimension less perameter (Reynold's no., Mech No., Prandtl, Pradtl No.etc.)

Unit – 4. Boundary layer definition and it's characteristics, Leminar boundary layer, Separation and it's control, Similarity solution of boundary layer equation, Boundary layer flow over flat plate, Stagnation point and boundary layer flow near this.

Books Recommended:

1. Introduction to Fluid Dynamics by Fay
2. Boundary Layer Theory by H. Schlichting
3. Introduction to Fluid Dynamics by R. K. Rathy

Code	Name	Lecture
MTM403	**Differentiable Manifolds**	4

Unit-1. Differentiable manifolds, examples, smooth maps, tangent vector and tangent space at a point on a manifold, tangent bundle of manifold.

Unit-2. Vector fields, Lie bracket, Jacobian of a smooth map, Lie derivatives, integral curves on manifolds, one parameter group of transformation and flows, Involutive distribution.

Unit-3. Cotangent space, differential forms, pullback of 1-form, tensor fields, exterior derivatives.

Unit-4. Connections, Geodesics, Covariant differentiations, Torsion, curvature, structure equations of Cartan, Bianchi identities.

Books Recommended:

1. Elementary Differential Geometry, B.O. Neill, Academic Publishers.
2. Differentiable Manifolds, U.C.De and A. Shahikh, Narosa Publications.
3. A Course in Differential Geometry and Lie Groups, S. Kumaresan, Hindustan Book Agency.
4. Differential Geometry of Manifolds, Stephen Lovett, A K Press, Ltd. Natick, Massachusetts.
5. An Introduction to Differentiable Manifolds and Riemannian Geometry, Boothby, Academic Press.
6. Differentiable Manifolds, Gerardo F. Torres del Castillo, Birkhauser

Code	Name	Lecture
MTM404	**Wavelet Analysis**	4

Unit I. **Fourier Transform**: Fourier transform in $L^1(\mathrm{P})$, properties of Fourier transforms Fourier transform in $L^2(\mathrm{P})$, Parseval Identities, Change of roof, Inversion formula, Plancherel Theorem, Duality Theorem, Poission summation formula, Sampling theorem, Heisenberg's uncertainty principle, Heisenberg's inequality, Discrete Fourier transform, Fast Fourier transform

Unit II. **Wavelet Transform**: Gabor transform, Parseval formula, Inversion formula, Continuous wavelet transform, Maxican hat wavelet, Properties of wavelet transforms, Discrete wavelet transform

Unit III. **Multiresolution Analysis and Construction of Wavelets**: Multiresolution Analysis**,** Mother wavelet, Haar wavelet, Shannon wavelet, Meyer wavelet, Franklin wavelet, Orthonormal spline wavelets, Compactly supported wavelets

Unit IV. **Wavelets and Applications**: Biorthogonal wavelets, Wavelets in several variables, Wavelet packets, Multiwavelets, Wavelet frames, Applications in Neural Networks, Turbulance and Medicine

Books Recommended

1. Khalil Ahmad and F. A. Shah: Introduction to Wavelets with Applications
   World Education Publishers, 2012

2. D. F. Walnut: An Introduction to Wavelet Analysis
   Birkhauser, Boston, 2002

3. C. K. Chui: Wavelets: A Tutorial in Theory and Applications
   Academic Press, Boston, MA.

Code	Name	Lecture
MTM405	**Software Engineering**	4

Introduction: 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.

Software Requirement Analysis and Specifications: Problem Analysis, Functional & Non-Functional Requirements, User & System Requirements, Requirements Engineering Process, Requirements Elicitation & Analysis Techniques, Requirements Validation, Requirements Management, Metrics for Analysis Model, Data Flow Diagrams, Data Dictionaries, Decision Table, Decision Tree, Software Requirement and Specifications.

Software Project Planning: Objectives, Project Size Estimation, Cost Estimation, Decomposition Techniques, Empirical Estimation Model, COCOMO Estimation Model, Project Scheduling & Tracking, Risk Management: S/W Risks, Risk Identification, Risk Refinement, Risk Monitoring & Management.

Software Design: Introduction, Principles, Abstraction, Refinement, Modularity, Information Hiding, Module Level Concepts: Cohesion, Coupling, Functional Independence, Design Models, Metrics for Design Model, Data Design, Object Oriented Design, User Interface Design, Component Design, Detailed Design Document.

Software Testing and Quality Assurance: Introduction, Error, Faults, Failure and Reliability, Testing Levels: Unit, Integration, Validation and System Testing, Functional and Structural Testing, Test Case Design, Quality Assurance and Standards.

References

- Prof. K.K. Aggarwal & Yogesh Singh: SOFTWARE ENGG:
- Pankaj Jalote, " An Integrated Approach to Software Engg" Narosa Publishing House, New Delhi.
- Pressman"Priciples of Software Engg" TMC, 5th Ed. 2005