Syllabus of M.Sc. Mathematics

Effective from Academic Session
2020-2021

Patel Nagar, Dehradun, Uttarakhand
Master of Science (Mathematics)-Two Year Programme- Choice Based Credit System

Admission to Master’s Program in Mathematics shall be through entrance examination conducted by University/Merit of qualifying exam and the program shall be based on the choice based credit system in which credit defines the quantum of content/ syllabus prescribed for a course system and determines the number of hours of instruction per week.

The student shall be eligible for admission to a Master’s Degree Program in Mathematics after he/she has successfully completed a three year undergraduate degree or earned prescribed number of credits through the examinations conducted by University as equivalent to an undergraduate degree with minimum 45% marks in undergraduate course.

Core courses prescribed for every Semester shall be mandatory for all students registered for the Master’s Program in Mathematics and shall carry minimum 86 credits. There shall be Elective courses offered in semester III and IV and shall carry a minimum of 21 credits. A self-study course would comprise of maximum 04 credits which shall not be included while calculating grades. There will be seminar/viva in each semester of credit 2 and will be based upon the concerned papers in that semester. In order to qualify for a two year master’s degree, a student must acquire a minimum of 86 credits including a minimum of 21 credits in both 3rd and 4th semester offered either by the parent department or other departments. A candidate has to obtain a minimum passing percentage shall be as per SGRR University norms which will be determined by adding both internal and external marks. (Two Sessional Tests marks plus End-Term Examination marks) to pass.
# M.Sc. Mathematics SYLLABUS

## Semester I

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L-T-P</th>
<th>Credits</th>
</tr>
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<tbody>
<tr>
<td>MMTC101</td>
<td>Differential Equations</td>
<td>4-0-0</td>
<td>4</td>
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<tr>
<td>MMTC102</td>
<td>Abstract Algebra –I</td>
<td>4-0-0</td>
<td>4</td>
</tr>
<tr>
<td>MMTC103</td>
<td>Mechanics</td>
<td>4-0-0</td>
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</tr>
<tr>
<td>MMTC104</td>
<td>Complex Analysis</td>
<td>4-0-0</td>
<td>4</td>
</tr>
<tr>
<td>MMTC105</td>
<td>Operations Research –I</td>
<td>4-0-0</td>
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</tr>
<tr>
<td>MMTP106</td>
<td>Presentation / Viva</td>
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Total Core Credits = 22

## Semester II

<table>
<thead>
<tr>
<th>Course Code</th>
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<th>L-T-P</th>
<th>Credits</th>
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<tbody>
<tr>
<td>MMTC201</td>
<td>Abstract Algebra- II</td>
<td>4-0-0</td>
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<tr>
<td>MMTC202</td>
<td>Discrete Structures</td>
<td>4-0-0</td>
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<tr>
<td>MMTC203</td>
<td>Operations Research- II</td>
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<tr>
<td>MMTC204</td>
<td>Real Analysis</td>
<td>4-0-0</td>
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<tr>
<td>MMTC205</td>
<td>Topology-I</td>
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Total Core Credits = 22
# Semester III

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<th>Credits</th>
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<tbody>
<tr>
<td>MMT301</td>
<td>Topology-II</td>
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<tr>
<td>MMT302</td>
<td>Functional Analysis</td>
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<td>Presentation / Viva</td>
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<tr>
<td>MMT304</td>
<td>Differential Geometry</td>
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<td>MMT305</td>
<td>Mathematical Statistics</td>
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<tr>
<td>MMT306</td>
<td>Calculus of Variations</td>
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<td>MMT307</td>
<td>Algebraic Coding Theory</td>
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<tr>
<td>MMT308</td>
<td>Computer Fundamentals</td>
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<tr>
<td>MMTS309</td>
<td>Mathematical Methods</td>
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**Elective Course:** Students have to select any three elective papers out of four

**Self-Study Course:** Students have to select any one self-study paper out of two.

**Total Credits (excluding Self-study Course) = 22**
## Semester IV

<table>
<thead>
<tr>
<th>Course Code</th>
<th>Course Name</th>
<th>L-T-P</th>
<th>Credits</th>
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<tr>
<td>MMTC401</td>
<td>Measure and Integration</td>
<td>4-0-0</td>
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<tr>
<td>MMTC402</td>
<td>Fluid Dynamics</td>
<td>4-0-0</td>
<td>4</td>
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<tr>
<td>MMTP403</td>
<td>Presentation/Viva</td>
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<tr>
<td>MMTE404</td>
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<tr>
<td>MMTE405</td>
<td>Fluid Mechanics</td>
<td>3-0-0</td>
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<tr>
<td>MMTE406</td>
<td>Fuzzy Set Theory</td>
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<td>MMTE407</td>
<td>Number Theory</td>
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<td>MMTS408</td>
<td>Self-Study Course:</td>
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<tr>
<td>MMTS409</td>
<td>Mathematical Modeling</td>
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<td></td>
<td>Special Theory of Relativity</td>
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</table>

Total Credits (excluding Self-study Course) = 20
SEMESTER - I

MMTC101: DIFFERENTIAL EQUATIONS

M.M: 100 Credit: 4 (Four Lectures Per Week)

UNIT I

Ordinary differential equations: Qualitative properties of solution, Oscillation, Wronskian, Sturm separation and comparison theorem, Picard iteration methods, Uniqueness and existence theorem.

UNIT II

Ordinary points, Regular and singular points, Frobenius series solution for Legendre’s and Bessel’s differential equations with generating functions.

UNIT III

Classification of PDE of 2nd order and canonical forms, Concept of separation of variable solution.

UNIT IV

Solution of heat diffusion, Laplace and wave equations, Non-linear partial differential equation of second order.

TEXT / REFERENCE BOOKS:


MMTC102: ABSTRACT ALGEBRA- I

M.M: 100                          Credit: 4 (Four Lectures Per Week)

UNIT I
Simple groups, Conjugacy, Normalization, Centre of a group, Class equation of a group and its consequences, Theorems for finite groups, Cauchy’s theorem, Sylow’s theorem.

UNIT II
Homomorphism, Endomorphism, Automorphism, Inner automorphism, Kernel of a homomorphism, Fundamental theorem on homomorphism of group, Group of automorphisms , Results on group homomorphism.

UNIT III
Maximal subgroups, Composition series, Jordan-Holder theorem, Solvable groups, Commutator subgroups, Direct products.

UNIT IV
Ideals, Algebra of ideals, Principal ideal ring, Units and associates, Polynomials ring, Division and Euclidean algorithm for polynomials, unique factorization theorem

TEXT / REFERENCE BOOKS:

MMTC103: MECHANICS

UNIT I
Conservation of linear and angular momentum under finite and impulsive forces, Conservation of energy.

UNIT II

UNIT III
Euler’s equations of motion, Kinetic energy, Eulerian angles, Instantaneous axis of rotation.

TEXT / REFERENCE BOOKS:
MMTC104: COMPLEX ANALYSIS

UNIT I

Power series of analytic functions, Convergence of power series, Radius of convergence, Taylor’s and Laurent’s series, Residue and poles, Singularities, Classification of singularities.

UNIT II

Residues, Residue at infinity, Cauchy residue theorem, Applications of residue theorem in evaluation of improper real integrals.

UNIT III

Conformal mapping: properties, Mobius transformation, Elementary examples.

UNIT IV

Maximum modulus theorem, Mittag-Leffler theorem, Rouche’s theorem, Concept of entire functions with simple example, Analytic continuation.

TEXT / REFERENCE BOOKS:

MMTC105: OPERATIONS RESEARCH- I

M.M: 100                                                                              Credit: 4 (Four Lectures Per Week)

UNIT I


UNIT II

Dual simplex method, Revised simplex method, Sensitivity analysis.

UNIT III

Assignment and Transportation problems.

UNIT IV

Theory of games, Integer linear programming.

TEXT / REFERENCE BOOKS:

MMTP 106: PRESENTATION / VIVA

M.M:100
Credit: 02

There will be presentation or viva based on the subjects of semester first.
SEMESTER - II

MMTC201: ABSTRACT ALGEBRA- II

M.M: 100 Credit: 4 (Four Lectures Per Week)

UNIT I
Embedding of rings, Ring of residue classes, Fundamental theorem on homomorphism of ring, Prime ideals, Maximal ideal.

UNIT II
Euclidean ring, Properties of Euclidean ring, Module, sub-module, Module homomorphism, Linear sum and direct sum of sub-module

UNIT III
Extension fields, Simple field extension, Algebraic field extension, Minimal polynomial, Roots of polynomials, Multiple roots, Splitting field.

UNIT IV
Automorphism of field, Fixed field, Normal extension, Galois group: Examples and characterizations, Construction with straight edge and compass.

TEXT / REFERENCE BOOKS:
MMTC202: DISCRETE STRUCTURE

M.M: 100 Credit: 4 (Four Lectures Per Week)

UNIT I

Recurrence relations, Linear homogeneous recurrence relations, Non-homogeneous recurrence relations, Solutions of recurrence relations.

UNIT II

Partially ordered sets, Different type of lattices, Sub-lattices, Direct product, Ideal Lattice, Modular and distributive lattices.

UNIT III

Boolean algebra, Ideals in Boolean algebra, Boolean rings, Boolean functions, Karnaugh maps, Application of Boolean algebra to switching theory.

UNIT IV

Graphs, Direct graphs, Undirected graphs, Relations and graphs, Path and circuits, Eulerian and Hamiltonian graphs, Planner graphs, Connected graphs.

TEXT / REFERENCE BOOKS:


MMTC203: OPERATIONS RESEARCH- II

M.M: 100                                                                                                          Credit: 4 (Four Lectures Per Week)

UNIT I

Inventory control, Functional role of inventory control, Classification of EOQ models with shortages and without shortages.

UNIT II

Queuing theory, Characteristics of Queuing system, Probability distribution in queuing system, Single served queuing model, M|M|1 queuing models, Multiple server queuing models.

UNIT III

Markov chain, Application of Markov analysis, State and transition probabilities, Steady state conditions, Sequencing problems, Processing n jobs through two and three machines.

UNIT IV

Dynamic programming, Dynamic programming under certainty, Non-linear programming methods, Quadratic programming, Kuhn- Tucker conditions.

TEXT / REFERENCE BOOKS:


MMTC204: REAL ANALYSIS

M.M: 100  
Credit: 4 (Four Lectures Per Week)

UNIT I

The Riemann-Stieltjes Integral: Definition and existence of Riemann-Stieltjes integral, Properties of integrals, Integration and differentiation, Fundamental theorem of calculus, Integration of vector-valued functions.

UNIT II

Sequences and series of functions, Pointwise and uniform convergence, Cauchy criterion for uniform convergence, Uniform convergence and continuity, Uniform convergence and Riemann-Stieltjes integral, Uniform convergence and differentiation, Weierstrass approximation theorem.

UNIT III

Power series, Algebra of power series, Uniqueness theorem for power series, Abel’s theorem, Taylor’s theorem.

UNIT IV

Functions of several variables, Concept of functions of two variables, Continuity, Partial derivatives, Differentiability, Change of variables, The inverse function theorem, The implicit function theorem, Chain rule.

TEXT / REFERENCE BOOKS:

MMTC205: TOPOLOGY I

M.M: 100                                                                     Credit: 4 (Four Lectures Per Week)

UNIT I
Metric on a set, Pseudo-metrics, Equivalent metrics, Limit point, Closed sets, Adherent point, Dense subsets, Interior of a set and its properties, Subspaces, Product spaces.

UNIT II
Convergent sequences, Cauchy sequences, Algebra of convergent sequences, Subsequences, Continuity at a point, Continuity over a space, Algebra of real valued continuous functions in a metric space, Homeomorphism, Isometrics, Uniform continuity.

UNIT III
Complete metric spaces, Completeness and continuous mappings, Cantor’s intersection theorem, Contraction mapping theorem, Connectedness in metric spaces, Properties of connectedness.

UNIT IV
Compact spaces, Compact subsets of the real line, Compactness and continuous mappings, Sequential compactness, Countable compactness, B-W property, B-W property and boundedness, B-W property and compactness, Compactness and uniform continuity, Lebesgue covering Lemma.

TEXT / REFERENCE BOOKS:

1. Introduction to Topology and Modern Analysis: G.F. Simmons, Tata McGraw-Hill.


MMTP 206: PRESENTATION / VIVA

M.M:100

Credit: 02

There will be presentation or viva based on the subjects of semester second.
**SEMESTER - III**

**MMTC301: TOPOLOGY - II**

M.M: 100                                                                 Credit: 4 (Four Lectures Per Week)

**UNIT I**

Definition and examples of topological spaces, Closed sets, Closure, Dense subsets, Neighborhoods, Interior, Exterior and accumulation points, Bases and subbases, subspaces, Product spaces and relative topology.

**UNIT II**

Continuous function, Homeomorphism, Connected and disconnected sets, Components, Locally connected spaces.

**UNIT III**

Countability axioms, First and second countable spaces, Lindelof’s theorem, Separable spaces, Second countable and separability, Separable axioms: T0, T1, T2, T3, T4 and their characterizations.

**UNIT IV**

Compactness, Continuity and compact sets, Basic properties of compactness, Compactness and finite intersection property, Sequentially and countably compact sets, Local compactness, Tychonoff’s theorem.

**TEXT / REFERENCE BOOKS:**


MMTC302: FUNCTIONAL ANALYSIS

M.M: 100

Credit: 4 (Four Lectures Per Week)

UNIT I

Normed linear spaces, Banach spaces, Subspaces, Quotient Spaces, Equivalent, Norms.

UNIT II

Bounded linear Transformation/operators, Hahn-Banach theorem, Open mapping theorem, Closed graph theorem, Uniform boundedness principle.

UNIT III

Inner product spaces, Hilbert spaces, Orthogonality of vectors, Orthogonal Complements and projection theorem, Riesz representation theorem, Orthonormal Sets.

UNIT IV

Operators on Hilbert Spaces, Self-adjoint, Normal and unitary operators, Orthogonal projection operators.

TEXT / REFERENCE BOOKS:

MMTP 303: PRESENTATION / VIVA

M.M:100

Credit: 02

There will be presentation or viva based on the subjects of semester third.
MMTC304: DIFFERENTIAL GEOMETRY

M.M: 100

Credit: 4 (Four Lectures Per Week)

UNIT I

Curves in space; Arc length, Order of contact, Tangent, Normal, Binormal, Osculating, Plane, Serret-Frenet formulae, Curvature and torsion. Osculating circle and osculating sphere, Helix, Bertrand curves.

UNIT II

Behaviour of a curve in the neighbourhood of a point. Concept of a surface, Envelope and developable surface, Parametric curves, Family of the surfaces, Edge of regression, Ruled surfaces, Central points.

UNIT III

Fundamental forms and curvature of surfaces: First fundamental form. Second fundamental form of the surfaces of revolution, Weingarten's equation, Direction coefficients, Family of curves.

UNIT IV

Local non-intrinsic properties of a surface Normal curvature, Principal directions, Principal curvatures, Minimal surface, Lines of curvature. Rodrigues and Monge's theorem, Euler's theorem, Joachimisthal's theorem, Dupin's indicatrix, Third fundamental form.

TEXT / REFERENCE BOOKS:

MMTC305: MATHEMATICAL STATISTICS

M.M: 100

Credit: 4 (Four Lectures Per Week)

UNIT I

Elements of probability, Sample space, Discrete probability, Baye’s theorem, Random variables and distribution functions, Mathematical expectations and moments.

UNIT II

Some standard discrete and continuous univariate distributions: Binomial, Poisson, Normal, Gamma and Beta distributions.

UNIT III

Correlation, Rank correlation, Regression line, Multiple and partial correlation of three variables only, Data reduction techniques, Canonical correlation.

UNIT IV

Concepts of sampling, Stratified sampling and systematic sampling, Test of hypothesis: t, z, chi square test.

TEXT / REFERENCE BOOKS:


MMTC306: CALCULUS OF VARIATIONS

M.M: 100                          Credit: 4 (Four Lectures Per Week)

UNIT I

Variation of functional, Continuity and differentiability of functional, Necessary condition for an extremum, Euler’s equation, Variational problems in parametric form, Functional depending on higher order derivatives and variational problems with subsidiary condition.

UNIT II

The isoperimetric problem, Invariance of Euler’s equation under Coordinate transformation, General variational of functional, Variable end point problems, Transversality condition transversal theorem, Weierstrass-Endmann corner condition.

UNIT III

Sufficient condition for extremum: second variation, Legendre’s and Jacobi’s necessary condition, Canonical transformation, Noether’s theorem, The principle of least action, Conservation law, Hamilton Jacobi’s equations.

UNIT IV

Transformation of ODE and PDE into functionals and their solutions by Ritze, Galerkin, Collocation and Kantrovitch methods.

TEXT / REFERENCE BOOKS:


MMTC307: ALGEBRAIC CODING THEORY

M.M: 100
Credit: 4 (Four Lectures Per Week)

UNIT I

The communication channel, The coding problem, Types of codes, Error detecting and error-correcting codes, Linear codes, Hamming metric, Description of linear block codes by matrices.

UNIT II

Dual codes, Standard array, Step-by-step decoding, Modular representation, Error-correction, Capabilities of linear codes, Bounds of minimum distance for block codes, Plotkin bound, Hamming sphere packing bound, Bounds for burst-error detecting and correcting codes.

UNIT III

Important linear block codes, Hamming codes, Golay codes, Perfect codes, Quasiperfect codes, Reed-Muller codes, Codes derived from Hadamard matrices, Product codes, Concatenated codes.

UNIT IV

A double error correcting decimal code and an introduction to BCH codes, BCH bounds, Cyclic codes, Matrix representation of cyclic codes, Error detection and cyclic codes, MDS codes.

TEXT / REFERENCE BOOKS:

1. Fundamental of Error-Correcting Codes: V. Pless and W.C. Huffman, Cambridge Univ. Press.


MMTS308: COMPUTER FUNDAMENTALS AND DATA STRUCTURES

UNIT I

History and classification of computers, Fundamentals of computer system: Data types, Number system, Complements; Floating point representation, Normalized floating point representation, Fixed point represented arithmetic computations.

UNIT II

Truth tables, Boolean algebra, De-Morgan’s theorem, Logical gates, Logic diagram, Logical expressions/functions, Karnaugh maps, Sum of product and product of sum, Combinational circuits and integrated circuits.

UNIT III

Introduction to data structures, Arrays, Stack and queues, Linked lists, Singly and doubly linked lists, Binary trees, Operations on binary trees and applications.

UNIT IV

Sorting, Searching, Algorithms and graphs.

TEXT / REFERENCE BOOKS:

UNIT I
Hermite polynomial.

UNIT II
Chebyshev polynomials.

UNIT III
Laguerre polynomials.

UNIT IV
Integral transforms.

TEXT / REFERENCE BOOKS:
SEMESTER IV

MMTC401: MEASURE AND INTEGRATION

M.M: 100
Credit: 4 (Four Lectures Per Week)

UNIT I
Lebesgue outer measure, Measure of open and closed sets, Borel sets, Measurable sets, Measure of cantor’s ternary set, Non-measurable sets.

UNIT II
Measurable functions, Algebra of measurable functions, Step functions, Characteristic function, Simple functions, Convergence in measure, Egoroff’s theorem, Riesz theorem.

UNIT III
Lebesgue Integral and their properties, General Lebesgue integrals, Lebesgue integrals for unbounded functions, Convergence theorems, Fatou Lemma.

UNIT IV
Functions of bounded variations, Absolutely continuity, Variation function, Jordan-decomposition theorem, Indefinite integral and its characterizations, Differentiation of an integral, Lebesgue differentiation theorem.

TEXT / REFERENCE BOOKS:
MMTC402: FLUID DYNAMICS

M.M: 100 Credit: 4 (Four Lectures Per Week)

UNIT I

Kinematics of fluids, Lagrangian and Eulerian methods, Local and individual time rates of change, Equation of continuity, Boundary surface.

UNIT II

Equation of motion of inviscid fluids, Euler’s equation of motion, Bernoulli’s equation, Lagrange’s equation, Conservative field of force, Cauchy’s Integral, Helmholtz’s equation.

UNIT III

Impulsive motion of a fluid, Energy equation of inviscid fluid, General theory of irrotational motion, Connectivity, Flow and circulation, Kelvin’s circulation theorem, Stokes’s theorem, Permanence of irrotational motions, Green’s theorem, Kinetic energy of finite and infinite liquid, Kelvin’s minimum energy theorem, Mean value of the velocity potential over a spherical surface.

UNIT IV

Motion in two dimensions, Stream function, Complex potential, Source, Sink, Doublet, Complex potential and images with respect to straight line and circle, Milne-Circle theorem, Blausius theorem.

TEXT / REFERENCE BOOKS:

MMTP 403: PRESENTATION / VIVA

M.M: 100

Credit: 03

There will be presentation or viva based on the subjects of semester fourth.
MMTE404: LINEAR INTEGRAL EQUATIONS

M.M: 100 Credit: 03

UNIT I
Classification of integral equations, Relation between differential and integral Equations, Fredholm integral equations, Fredholm equations of second kind with Separable kernels, Eigen values and Eigen functions

UNIT II
Volterra integral equations, Resolvent kernel of Volterra equation, Convolution type kernel, Integral equations with symmetric kernel.

UNIT III
Method of successive approximation for Fredholm and Volterra equations of the second kind.

UNIT IV
Classical Fredholm theory, Singular integral equations, Hilbert type integral equations, Integral equation with Green’s function type kernels.

TEXT / REFERENCE BOOKS:
1. Integral Equations and Boundary Value Problem : M.D. Raisinghania, S. Chand.
MMTE405: FLUID MECHANICS

UNIT I
Motion of the cylindrical and elliptic cylinders.

UNIT II
Motion of Sphere, Motion of a sphere in an infinite mass of the liquid at rest at infinity, Liquid streaming past a fixed sphere, Equation of motion of a sphere, Pressure distribution.

UNIT III
General theory of stresses and rate of strains, Newton’s law of viscosity, State of stress, Principal stresses and principal directions, Transformations of two and three stresses components and rate of strain components, Relation between stresses and rate of strain components, Translation, Rotation and rate of deformation.

UNIT IV
Navier-Stokes equation of motion; Energy equation for viscous fluid, Energy dissipation due to viscosity.

TEXT / REFERENCE BOOKS:
4. Fluid Dynamics: M.D. Raisinghania, S. Chand.
MMTE406: FUZZY SET THEORY

UNIT I
Fuzzy sets, Basic definitions, Alpha-cut sets, Convex fuzzy sets, Basic operation on fuzzy sets, Types of fuzzy sets, Cartesian products, Algebraic products, Bounded sum and differences, $t$-norms and $t$-corners.

UNIT II
The extension principle, The Zadeh’s extension principle, Images and inverse image of fuzzy sets, Fuzzy numbers, Element of fuzzy arithmetic.

UNIT III

UNIT IV
Fuzzy logic, An overview of classical logic, Multivalued logic, Fuzzy propositions, Fuzzy qualifiers, Linguistic variables and hedge.

TEXT / REFERENCE BOOKS:
MMTE407: NUMBER THEORY

UNIT I

The division algorithm, The gcd, The Euclidean algorithm, Diophantine equation \( ax + by = c \), The fundamental theorem of arithmetic, The sieve of Eratosthenes, Goldbach conjecture.

UNIT II

The theory of congruences, Binary and decimal representation of integers, Linear congruence and Chinese remainder theorem, Fermat’s theorem, Wilson’s theorem.

UNIT III

Number theoretic function, Tau and sigma function, the Mobius inversion formula, The greatest integer function, Euler’s phi function, Properties of phi function, Euler theorem.

UNIT IV

The order of an integer modulo n, Primitive roots for primes, Composite numbers having primitive roots, The theory of indices, Continued fraction, Approximation of irrationals by rationals.

TEXT / REFERENCE BOOKS:

UNIT I

Mathematical Modeling through ordinary differential equations of first order, Linear growth and decay models, Non-linear growth and decay models, Compartment models- dynamics problem, Geometrical problems.

UNIT II

Mathematical Modeling through systems of ordinary differential equations of first order, Population dynamics, Epidemics-compartment models, Economics, Medicine, Arm- race, Battles and international trade- dynamics.

UNIT III

Mathematical modeling through ordinary differential equations of second order, Planetary motions, Circular motion, Motion of satellites, Mathematical modeling through linear differential equations of second order, Miscellaneous mathematical models.

UNIT IV

Mathematical modeling through difference equations, Simple models, Basic theory of linear difference equations with constant coefficients, Economics and finance- population- dynamics and genetics- probability theory.

TEXT / REFERENCE BOOKS:


UNIT I
Special theory of relativity, Galilean transformation, Maxwell’s equations.

UNIT II
The ether theory, The principle of relativity, Relativistic kinematics, Lorentz transformation equations.

UNIT III
Events and simultaneity, Example of Einstein strain, Time dilation, Longitudinal Contraction.

UNIT IV
Invariant Interval, Proper time and proper distance, World line, Example of twin paradox, Addition of velocities, Relativistic Doppler’s effect.

TEXT / REFERENCE BOOKS: