SYLLABUS
M.SC. Mathematics (Part-I)
Session 2025 onwards
SEMESTER-I

LIST OF CORE SUBJECTS :

Code	Title of Paper/Subject	Credit	Internal Assessment	External	Total
MM101	Algebra-I	5	30	70	100
MM102	Topology -1	5	30	70	100
MM 103	Complex Analysis	5	30	70	100
MM104	differential equation-1	5	30	70	100

ELECTIVE COURSES : (ANY ONE OF TWO)

MM105	Linear Programming	5	30	70	100
MM 106	Introduction to Information Technology	3	10	70	80
MM 106(P)	Introduction to Information Technology LAB	2	—	20	20
MM107	Mathematical Statistics	5	30	70	100

Category-I

MM101 ALGEBRA - I

Time Allowed: 3 hours

External Exam: 70
Internal Assessment: 30
Total: 100

Course Outcomes:

C.O.(1) : To understand some interesting results of Group actions like Class Equation etc
C.O.(2) : Able to learn Lagrange's Theorem, structure theory of groups, solvability and nilpotency of groups
C.O.(3) : To understand the Symmetric groups, Alternating Groups and their simplicity..
C.O.(4) : To know how to apply Sylow Theory to determine structure of groups of finite order
C. O.(5): To understand the basic properties of Rings and Ideals

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Section C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly. Each question in sections A and B will be of 10 marks each and section C will be of 30 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION-A

Review of groups, Normal and subnormal series, Solvable groups, Nilpotent groups, Composition Series, Jordan-Holder theorem for groups. Group action, Stabilizer, orbit, Class equation and its applications, permutation groups, cyclic decomposition, conjugacy classes in permutation groups. Alternating group An, Simplicity of An.

SECTION-B

Structure theory of groups, Fundamental theorem of finitely generated abelian groups, Invariants of a finite abelian group, Groups of Automorphisms of cyclic groups, Sylow's theorems, Groups of order p^2, pq. Review of rings and homomorphism of rings, Ideals, Algebra of Ideals, Maximal and prime ideals, Ideal in Quotient rings, Field of Quotients of integral Domain, Matrix Rings and their Ideals: Rings of Endomorphisms of Abelian Groups.

Books Recommended

1. Bhattacharya, Jain & Nagpal: Basic Abstract Algebra, Second Edition .
2. Surjeet Singh. Qazi Zameeruddin: Modern Algebra
3.M.L. khanna ,bhambri: A course in Abstract Algebra,third Edition

MM102: TOPOLOGY-I

Time Allowed: 3 hours

External Exam: 70
Internal Assessment: 30
Total: 100

Course Objectives:

CO1 :Can differentiate between finite, countable, uncountable sets and understand the concept of open-sets, closed set, interior and exterior points.
CO2:Can understand the topological properties like compactness, connectedness and the countability axioms and find their numerous uses in the course.
CO3:The concepts of basis and sub-basis of a space, of interior and closure set the stage for the most general study of continuity.
CO4:Enables the student to understand the special characters of the metric spaces as an important special case of a topological space.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Section C will consist of one compulsory question having ten short questions covering the entire syllabus uniformly. Each question in sections A and B will be of 10 marks each and section C will be of 30 marks.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions from each sections A and B and compulsory question of section C.

SECTION A

Cardinals: Equipotent sets, Countable and Uncountable sets, Cardinal Numbers and their Arithmetic, Bernstein's Theorem and the Continumm Hypothesis.
Topological Spaces: Definition and examples, Euclidean spaces as topological spaces, Basis for a given topology, Topologizing of Sets; Sub-basis, Equivalent Basis.
Elementary Concepts: Closure, Interior, Frontier and Dense Sets, Topologizing with pre-assigned elementary operations. Relativization, Subspaces. Characterization of Continuity, Continuity at a point, Homeomorphisms and Embeddings.

SECTION B

Cartesian Product Topology. Elementary Concepts in Product Spaces, Continuity of Maps in Product Spaces and Slices in Cartesian Products.
Connectedness: Connectedness and its characterizations, Continuous image of connected sets, Connectedness of Product Spaces. Applications to Euclidean spaces. Components, Local Connectedness and Components, Product of Locally Connected Spaces. Path Connectedness.
Compactness and Countability: Compactness and Countable Compactness, Local Compactness, One-point Compactification, To, Ti, and T2 spaces, T2 spaces and Sequences and Hausdorfness of One-Point Compactification.

Books Recommended

1. W.J. Pervin Foundations of General Topology, New York, Academic Press, Ch. 2 (Sections 2.1, 2.2), Section 4.2, and Ch 5 (Sec 5.1 to 5.3).
2. James Dugundji: TOPOLOGY. Allyn and Bacon. Relevant Portions from Ch.III

References:

1. James Munkres: Topology, 2nd Edition Pearson.

MM 103COMPLEX ANALYSIS

Max Marks :100
Internal Assessments: 30
External Examination:70

Time: 3 hours.

Course objectives: This course is aimed to provide an introduction to the theories for functions of a complex variable. It begins with the exploration of the algebraic, geometric and topological structures of the complex number field. The concepts of analyticity, Cauchy-Riemann relations, and harmonic functions are then introduced. Students will be prepared with an understanding of the fundamental concepts of complex variable theory. Also students will acquire the skill of contour integration to evaluate complicated real integrals via residue calculus.

Course Learning Outcomes: Upon completion of this course, students should be able to:

- Represent complex numbers algebraically, geometrically and analyze limits and continuity for complex functions as well as consequences of continuity.
- Apply the concept of analyticity and the Cauchy-Riemann equations and of results on harmonic and entire functions including the fundamental theorem of algebra.
- Evaluate complex contour integrals directly and by the fundamental theorem, apply the Cauchy integral theorem in its various versions, and the Cauchy integral formula
- Represent functions as Taylor, power and Laurent series, classify singularities and poles, find residues and evaluate complex integrals using the residue theorem.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each carrying 10 marks from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short questions carrying 3 marks each covering the entire syllabus uniformly.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two questions each from Section Aand Section B and compulsory question of section C.

SECTION-A

Complex Differentiation: Functions of a complex variable, Analytic function, Cauchy-Riemann equations (Cartesian and polar form), Harmonic function and Harmonic conjugates, construction of analytic functions. Branches of multivalued functions withreference to arg z,logz and z^c

Complex Integration: Line integral, Cauchy's theorem, Cauchy Goursat theorem, Cauchy's Integral formula, Cauchy's inequality, Poisson's integral formula, Morera's theorem, Liouville's theorem, Fundamental theorem of Algebra.

SECTION-B

Power series, Taylor's theorem, Laurent series. Maximum Modulus Principle, Minimum Modulus Principle, Schwarz Lemma. Zeros and Singularities of a function, Meromorphic and entire functions: Residues at a pole and at infinity, Cauchy's theorem on residues. Argument Principle, Rouche's theorem, Fundamental Theorem of Algebra.Principal of analytic continuation,General definition ofan analytic function.Analytic continuation by power series method,Natural boundary,Harmonic function on a disc,Schwarz reflection principal.

RECOMMENDED AND SUGGESTED READINGS(R&S):

1. J. W. Brown & R.V. Churchill: Complex Variables and Applications, McGraw Hill, 2009.
2. S. Ponnusamy: Foundations of Complex Analysis, Narosa Publishing House, 2019.
3. E. T. Copson: An introduction to Theory of Functions of a Complex Variable, Oxford University Press,

MM 104 DIFFERENTIAL EQUATIONS-1

Duration: 3 Hrs.

Max. Marks: 100
Internal Assessment: 30
External Examination: 70.

Course Learning Outcomes:

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

CO-1 Understand the existence, uniqueness and continuity of solutions of first order ODB's

.CO-2 Evaluate the solutions of initial and boundary value problems.

CO-3 Understand the eigen values and eigen functions of Sturm-Liouville systems

CO-4 Analyze the qualitative behavior of solutions of system of differential equations

Instructions for Paper Setter/Examiner

The question paper covering the entire course shall be divided into three parts: A, B & C. Each of sections A and B will have 4 questions from the respective sections of the syllabus of 10 marks each and section C will consist of compulsory question having 10 parts of short-answer type of 3 marks

Instructions for Candidates

Candidates are required to attempt five questions in all, selecting two questions from section A and B each and the compulsory question from section C.

Section - A

Existence of Solution of ODE of First Order, Initial Value Problem, Ascoli's Lemma, Gronwall's Inequality, Cauchy Peano Existence Theorem, Uniqueness of Solutions, Method of Successive Approximations. Existence and Uniqueness Theorem. System of Differential Equations, nth order Differential Equation, Dependence of Solutions on Initial Conditions and Parameters,

Section-B

Linear System of Equations (Homogeneous & Non-Homogeneous). Superposition Principle, Fundamental Set of Solutions, Fundamental Matrix, Wronskian, Abel Liouville Formula, Reduction of Order, Adjoint Systems and Self Adjoint Systems of Second Order.

Linear 2nd Order Equations, Preliminaries, Sturm's Separation Theorem, Sturm's Fundamental Comparison Theorem, Sturm Liouville Boundary Value Problem, Characteristic Values & Characteristic Functions, Orthogonality of Characteristic Functions, Expansion of a Function in a Series of Orthonormal Functions, Floquet Theory

Reference Books:

1. S.L. Ross, Differential Equations, 3" edition, John Wiley & sons (Asia), 2007.
2. E.Coddington& N. Levinson. Theory of Ordinary Differential Equations, Tata Mc-Graw Hill, India
3. G.F. Simmons, Differential Equations with applications and historical notes, Taylor & Francis, 3 ed.

MM105 LINEAR PROGRAMMING

External Exam: 70
Time Allowed: 3 hours Internal Assessment: 30
Total: 100

Course objectives: To train the student in the domain of linear programming. To give sufficient tools for solving linear programming problems which can be used by students for further applications in different areas of interest.

Course Learning Outcomes: Upon the completion of this course, students will be able to:

- Formulate, Understand and apply the concept of optimality criteria for various type
- of optimization problems.
- Solve the transportation and assignment problems.
- Identify strategic situations and also find sequencing Problems.
- Apply the methods of optimization in real life situation.

INSTRUCTIONS FOR THE PAPER-SETTER

The question paper will consist of three sections: A, B and C. Sections A and B will have four questions each from the respective sections of the syllabus. Sections C will consist of one compulsory question having ten short answer covering the entire syllabus uniformly. The weightage of section A and B will be 30% and that of section C will be 40%. Use of scientific calculator is allowed.

INSTRUCTIONS FOR THE CANDIDATES

Candidates are required to attempt five questions in all selecting two question from each sections A and B and compulsory question of section C. Use of non-programmable scientific calculator is allowed.

Section-A

Linear programming problems (LPPs); Examples, Mathematical formulation, Graphical solution, Solution by Simplex method, artificial variables, Big-M method and two phase simplex method. Duality in linear programming;Concept,Mathematical formulation, fundamental properties of duality, duality and simplex method and dual simplex method. Sensitivity Analysis: Discrete changes in the cost vector, requirement vector and Co-efficient matrix.

Section –B

Transportation problem; Introduction, Mathematical formulation of the problem, initial basic feasible solution using North West Corner Method, Least Cost Method and Vogel's Approximation Method, Optimal solution using MODI method, degeneracy in transportation problems, some exceptional cases in transportation problems.

Assignment problem; Introduction, Mathematical formulation of an assignment problem, assignment algorithm, unbalanced assignment problems. maximization case in assignment problem Travellingsalesman problem.

Games & Strategies: Definition & characteristics of Games, Maximin-minimax principle, Two person zero sum games, Games without saddle points, Mixed Strategies, Concept of Dominance, Graphical method for solving games 2 x n & m x 2, Reducing the game to LPP limitation .

RECOMMENDED BOOKS:

1. Kanti Swarup, P.K. Gupta and Manmohan: 'Operations Research', Sultan Chand and Sons, New Delhi, Ed. 1996.
2. V.K. Kapoor: 'Operations Research', Sultan Chand and Sons.