KUMAUN UNIVERSITY, NAINITAL
Department of Mathematics

M. Sc. Mathematics
(Effective from 2015-16 Batch)

SEMESTERWISE COURSE STRUCTURE AND DETAILED SYLLABUS:

1. There shall be four semesters in the two- years M.A./M.Sc. Programme in Mathematics.
2. There will be five papers in each semester and one paper comprising viva-voce, comprehensive test and Seminar in semester 4.
3. Each paper will be of 100 marks. This will include a mid-semester/internal assessment of 25 marks in the form of written tests or practical tests in lab oriented courses. In view of the introduction of lab oriented courses, respective mathematics departments may make necessary changes in the intake of students.
4. Viva-voce, comprehensive test and seminar examination of 100 marks will be in semester 4. The board of examiners will consist of one external and one internal examiner recommended for appointment by the BOS.
5. There shall be 500 marks each for semester 1, 2 and semester 3, while 600 marks for semester 4. Thus, for the entire programme the total of marks shall be 2100.
6. Question Paper Structure: Duration of the semester-end examination will be three hours. Each paper in the examination will be of seventy five marks and will comprise of three sections: A, B and C. Questions within each section will carry equal marks. Section A will be of 15 marks and shall contain ten objective type questions of 1.5 marks each. Section B will be of 30 marks and will contain 6 questions of 7.5 marks each. The candidate will have to attempt any four questions in this section. Section C will be of 30 marks and shall contain 4 questions. The candidate will have to answer two questions in section C.

Semester wise Course Structure

First semester	**Second semester**	**Third semester**	**Fourth semester**
MAT 401C: Real Analysis	MAT 402C: Complex Analysis	MAT501C: Linear Algebra	MAT502C: Dynamics of Rigid Bodies
MAT403C :Topology	MAT 404C: Abstract Algebra	MAT503C: Measure Theory	MAT504C: Functional Analysis
MAT 405C: Differential Geometry and Tensor Calculus	MAT 406C: Differential Equations	MAT 505C: Numerical Analysis	MAT506C: Calculus of variation and Integral Equations
Elective	***Elective***	***Elective***	***Elective***
Elective	***Elective***	***Elective***	***Elective***
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Paper codes ending with letter C, are compulsory
Paper codes ending with letter E, are elective

Elective Courses for Odd (First and Third) Semesters:

MAT 01E: Mathematical Statistics
MAT 03E: Number Theory
MAT 05E: Fluid Mechanics
MAT 07E: Discrete Mathematics
MAT 09E: Computer Programming and Mathematical Computations
MAT 11E: Special Functions
MAT 13E: Fourier Analysis
MAT 15E: Financial Mathematics

For Details, please see 'Elective courses for I & III Semester'

M.A. /M.Sc. (Semester III)

MAT 501: Linear Algebra

Unit 1. A brief review of vector space, Inner products, Orthogonality, Best approximations, Projections, Cauchy-Schwartz inequality.
Unit 2. Adjoint of a linear transformation, Self adjoint transformations, Unitary operators.
Unit 3. Normal operators: Definition and properties.
Unit 4. Spectral theory for normal operator, Polar decomposition of a linear operator, Roots of a family of normal operators, Self adjoint algebra generated by a family of linear operators.
Unit 5. Eigen vectors and eigen values of a linear operator, Minimal polynomial of a linear operator and its relations to characteristic polynomial, Caley-Hamilton theorem.

Books Recommended:

1. Hadley: Linear Algebra.
2. Hoffman and Kunz: Linear Algebra, Prentice Hall of India, New Delhi, 1972.
3. H. Helson: Linear Algebra, Hindustan Book Agency, New Delhi, 1994.
4. K. B. Dutta: Matrix and Linear Algebra, Prentice Hall of India.

MAT 503C: Measure Theory and Integration

Unit 1. Countable sets, uncountable sets, relation between the cardinality of a nonempty set and the cardinality of its power set; Boolean ring, σ-ring, Boolean algebra and σ-algebra of sets, Set function.
Unit 2. Lebesgue Measure: Introduction, Outer measure, Measurable sets and Lebesgue measure, Example of nonmeasurable sets, Measurable functions.
Unit 3. The Lebesgue Integral: The Riemann integral, The Lebesgue integral of a bounded function over a set of finite measure, The integral of nonnegative functions. The general Lebesgue integral, Convergence in measure.
Unit 4. Differentiation and Integration: Differentiation of monotone functions, Functions of bounded variation, Differentiation of an integral, Absolute continuity, Convex functions.
Unit 5. General Measure and Integration Theory: Measure spaces, Measurable functions, Integration, General convergence theorems, Signed measures, The Radon-Nikodym Theorem, The L^p spaces, Measure and Outer Measure, Outer measure and measurability, The extension theorem, Product measures, Integral operators, Inner measure, Caratheodory outer measure, Hausdorff measures.

Books Recommended:

1. P. K. Jain: Measure Theory, New Age International.
2. P. R. Halmons: Measure Theory, Grand Text Mathematics, 14 Springer, 1994.
3. E. Hewit and K. Stromberg: Real and Abstract Analysis, Springer, 1975.
4. K.R. Parthasarathy: Introduction to Probability and Measure, TRIM 33, Hindustan Book Agency, New Delhi, 2005.
5. I. K. Rana: An Introduction to Measure and Integration, (Second Edition), Narosa Publishing House, New Delhi, 2005.

MAT 505C: Numerical Analysis

Unit 1. Errors in numerical Calculations: Absolute, Relative, Percentage errors, General Error, Error in series approximation. Solutions of Algebraic and Transcendental Equation: Bisection method, False position method, Newton-Raphson and generalized Newton's Method, Graffe's root squaring method, Lin Bairstow's method, Picards iteration method, convergence and error estimates of iterative methods.

Unit 2. Linear systems of equations: Consistency of Linear System of equations, Solutions of Linear Systems by direct method: Guassian elimination and computation of inverse of a matrix, Method of Factorization, Solutions of Tridiagonal systems and ill conditioned linear systems. Solutions of linear systems by iterative methods: Jacobi method, Gauss- Siedel method. The eigenvalue problem.

Unit 3. Interpolation and curve fitting: Errors in Polynomial interpolation, Finite differences, Differences of a polynomial, Newton's forward and backward interpolation, Central differences, Gauss, Stirling, Bessel's and Everett's Formulae, Practical interpolation and interpolation with unevenly spaced points, Lagrange's Interpolation formula, Divided difference and Newton's General interpolation formula, Least square curve fitting procedure, B-Splines representations and least square solution.

Unit 4. Numerical differentiation and integration: Numerical differentiation, cubic Spline method, Maximum and minimum values of tabulated function, Newton-Cotes Integration formula, Numerical integration by Trapezoidal rule, Simpson'1/3, Simpson's 3/8, Weddle's rule and Romberg Integration.

Unit 5. Numerical Solution of ordinary and Partial Differential equations: Numerical solution of ODE by Picard's, Euler's, Modified Euler's and Runge-Kutta methods. Finite difference method for solving Boundary value problems, finite difference method for solving parabolic, elliptic and hyperbolic PDE.

Practical assignments: Based on topics included in the paper with OCTAVE.

Books Recommended:

1. S. S. Sastry: Introductory Methods Numerical Analysis, Prentice- Hall of India.
2. C.F. Gerald and P. O. Wheatley: Applied Numerical Analysis, Addison- Wesley, 1998.