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 Even (Second and Fourth) Semesters:

MAT 02E: Relativity
MAT 04E: Riemannian Geometry
MAT 06E: Advanced Abstract Algebra
MAT 08E: Operations Research
MAT 10E: Statistical Analysis
MAT 12E: Theory of Computation
MAT 14E: Design and analysis of algorithm
MAT 16E: Coding Theory
MAT 18E: Dynamical Systems
For Details, please see 'Elective courses for II & IV Semester'

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

MAT 502: Dynamics of Rigid Bodies
Unit 1. D'Alembert's principle, Motion about a fixed axis (Finite and Impulsive forces).
Unit 2. Motion in two dimensions under Finite and Impulsive forces.
Unit 3. Principle of conservation of momentum and energy.
Unit 4. Lagrange's equations in generalized co-ordinates.
Unit 5. Hamilton's principle, principle of least action, Euler's geometrical and dynamical equations.

Books Recommended:
1. S. L. Loney: Dynamics of rigid bodies.
2. Bhu Dev Sharma: Dynamics of Rigid Bodies, Kedarnath Ramnath Sons, 1984.
3. M. Ray & Harswarup Sharma: A text book of Dynamics of Rigid Body, Students' Friends & Co., Agra-2, 1971.
4. A. S. Ramsey: Dynamics – Part II.
5. H. Goldstein: Classical Mechanics, Narosa, 1990.

MAT504: Functional Analysis
Unit 1. Metric convergence of sequences, Normed spaces, Banach Space, Properties of Normed spaces, Finite dimensional normed spaces and subspaces; Compactness and finite dimension, linear operators, Bounded and continuous linear operators; Linear functional; linear operators and functional on finite dimentional spaces, Normed spaces of operators, Dual space.
Unit 2. Inner product space; Hilbert space; Properties of Inner product spaces, Orthogonal complements and direct sums, Orthonormal sets and sequences; Hilbert adjoint operators, Self-Adjoint, Unitary and normal operators.
Unit 3. Fundamental Theorems of Normed and Banach Space: Zorn's Lemma, Hahn Banach Theorem, Hahn Banach Theorem for complex vector spaces and normed spaces, Applications to bounded linear fuctionals on C[a, b], Adjoint operators, Uniform boundedness theorem, strong and weak convergence, convergence of sequences of operators and functional, Applications of summability of sequences, Open mapping theorem and closed graph theorem.
Unit 4. Banach contraction principle, Applications of Banach's theorem to linear, differential and integral equations, Approximation in Normed spaces, Uniqeness, strict convexity, Uniform approximation, approximation in Hilbert spaces.
Unit 5. Compact linear operators on normed spaces, properties of compact linear operators, spectral properties of compact linear operators, operator equations involving compact linear operators.

Books Recommended:

1. Erwin Kreyszig: Introductory Functional Analysis, Wiley India edition.
2. G. F. Simmons: Introduction to Topology and Modern Analysis, McGraw Hill, 1963.
3. A. E. Taylor: Introduction to Functional Analysis, John Wiley, 1958.
4. R. E. Edwards: Functional Analysis, Holt Rinehart and Winston, 1965.

MAT 506C: Calculus of Variations and Integral equations

Unit 1. Functionals and extremals, Necessary and sufficient conditions for extrema, Variation and its properties.

Unit 2. Euler equations, Cases of several dependent and independent variables, Variational methods for boundary value problems in ordinary and partial differential equations, Functionals dependent on higher derivatives, Parametric forms, Simple applications.

Unit 3. Classification of linear integral equations, Relation between differential and integral equations.

Unit 4. Fredholm equations of second kind with separable kernels, Fredholm alternative theorem, Eigen values and eigen functions.

Unit 5. Method of successive approximation for Fredholm and Volterra equations, Resolvent kernel.

Books Recommended:

1. L. Elsgolts: Differential Equations and Calculus of Variations, Mir Publishers, 1970.
2. A. S. Gupta: Calculus of Variations, Prentice Hall of India, New Delhi, 1999.
3. J. H. Davis: Methods of Applied Mathematics with a MATLAB Overview, Birkhäuser, Inc., Boston, MA, 2004.
4. L.G. Chambers: Integral Equations A short Course, Int. Text Book company Ltd. 1976 .
5. Abdul J Jerry: Introduction to Integral Equations with Applications, Marshal and Dekkar.
6. Naveen Kumar: An Elementary Course on Variational Problems in Calculus, Narosa, 2004.

MAT 508C: Viva-Voce, Comprehensive Test and Seminar

1. In this paper evaluation will be based on the student's performance in viva voce, comprehensive test and presentation /seminars on any current topic in mathematics.
2. The respective departments will decide the schedule of conducting the seminars during the fourth semester and a hardcopy of the same will be submitted by the students at the time of viva voce examination.
3. Marks for the presentation/seminars will be allotted out of Twenty five marks.
4. The Viva-Voce examination and comprehensive test will be conducted together.
5. The subject comprehensive test will be of 25 marks consisting of short answer questions.
6. During the viva-voce examination subject knowledge of the students based on the courses studied during the course program will be tested by the examiners. It will be graded out of fifty marks.
7. There shall be one external and one internal examiner to conduct the Viva-voce examination.