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'

SYLLABUS for COMPULSORY COURSES
M.A. /M.Sc. (Semester I)

MAT 401C: Real Analysis

Unit 1. Metric spaces: metric, Various examples of metric spaces, open sets, interior of a set, structure of open subsets of the real line, limit points, closed sets, closure of a set,

Unit 2. Cauchy sequences, completeness, continuity and uniform continuity, Compactness (Definition and examples only).

Unit 3. Functions of several variables: Concept of functions of two variables, Simultaneous limit and iterated limits in functions of two variable, Partial derivatives: Definition, Existence and continuity, Interchange of order of differentiation, Directional derivatives.

Unit 4. Composite functions, Linear continuity of functions of two variables, Differentiability of functions of two variables, Taylor's theorem.

Unit 5. Linear transformations, Vector valued functions, Differentiation of vector valued functions, inverse function theorem, implicit function theorem.

Books recommended:

1. *S. C. Malik and Savita Arora: Mathematical Analysis, New Age International.*
2. *G.F. Simmons: Introduction to Topology and Modern Analysis, Tata McGraw Hill.*
3. *W. Rudin: Principles of Mathematical Analysis (3rd edition), Tata Mc Graw Hill Kgakusha, International Student Edition, 1976.*
4. *T. M. Apostol: Mathematical Analysis, Narosa Publishing House, New Delhi, 1985.*

MAT 403C: Topology

Unit 1. Basic concepts in Topology**:** Topology on a set, a topological space with examples, topologies on the real number system, the extended real line, the discrete 2- spaces, and various other examples.

Unit 2. Neighbourhood of a point/set, open and closed sets, interior, boundary, closure, limit point, derived set of a set. Base and sub - base of a topology. Separable space, first, and second countable space.

Unit 3. Continuous map, open and closed maps, homomorphism, topological invariants, Pasting lemma, Subspaces, product of two spaces, arbitrary product spaces, quotient of a space, cylinder, cone, reduced suspension of a space, the unit closed interval, I=[0,1] of the real line, the Euclidean n-space, the unit circle and the n-sphere, n-torus, the projective n-spaces.

Unit 4. Compactness, compact space, Properties of compact spaces, compactness of a metric space. Connectedness, connected space, path connected space, components.

Unit 5. Separation axioms: T_1, T_2, $T_{3,}$ $T_{31/2,}$ T_4, regular, completely regular and normal space.

Books Recommended:

1. *J.R. Munkres: Topology: Narosa Publishing House.*
2. *Shaum's outlines series: Tata McGraw Hill.*
3. *K. D. Joshi: Introduction to General Topology, Wiley Eastern, 1983.*
4. *G. F. Simmons: Introduction to Topology and Modern Analysis, McGraw Hill, 1963.*
5. *M. D. Raisinghania & R. S. Aggarwal: Topology, S. Chand & Co.*

MAT 405C: Differential Geometry And Tensor Calculus

Unit 1. Curves in space, parameterized curves, regular curves, helices, arc length, reparametrization (by arc length), tangent, principal normal, binormal, osculating plane, normal plane, rectifying plane, curvature and torsion of smooth curves, Frenet-Serret formulae, Frenet approximation of a space curve.

Unit 2. Order of contact, Osculating circle, osculating sphere, spherical indicatrices, involutes and evolutes, Bertrand Curves, intrinsic equations of space curves, isometries of R^3, fundamental theorem of space curves, surfaces in $R,^3$ regular surfaces, co-ordinate neighbourhoods, parameterized surfaces, change of parameters, level sets of smooth functions on R^3, surfaces of revolution, tangent vectors, tangent plane. first and second fundamental forms, classification of points on a surface.

Unit 3. Curvature of curves on surfaces, normal curvature, Meusnier theorem,
principal curvatures, geometric interpretation of principal curvatures, Euler theorem, mean curvature, lines of curvature, Rodrigue's formula, umbilical points, minimal surfaces, definition and examples, Gaussian curvature, intrinsic formulae for the Gaussian curvature, isometries of surfaces, Gauss Theorem Egregium (statement only).

Unit 4. Christoffel symbols, Gauss formulae, Weingarten formulae, Gauss equations, Codazzi-Mainardi equations, curvature tensor, geodesics, geodesics on a surface of revolution, geodesic curvature of a curve, Gauss-Bonnet Theorem (statement only).

Unit 5. n-dimensional real vector space, contravariant vectors, dual vector space,
Covariant vectors, tensor product, second order tensors, tensors of type (r, s), symmetry and skew symmetry of tensors, fundamental algebraic operations: Addition, multiplication, contraction and inner product. Quotient law of tensors.

Books Recommended:

1. C.E. Weatherburn: Riemannian Geometry and Tensor Calculus.
2. Andrew Pressley: Elementary Differential Geometry, Springer (Undergraduate Mathematics Series), 2001.
3. J. A. Thorpe: Elementary Topics in Differential Geometry, Springer (Undergraduate Texts in Mathematics), 1979.
4. D. Somasundaram: Differential Geometry, A First Course, Narosa Publishing House, New Delhi, 2005.
5.T.J.Willmore: An Introduction To Differential Geometry, Oxford University Press.
6. R.S. Mishra: A Course in tensors with applications to Riemannian Geometry, Pothishala Pvt. Ltd. Allahabad, 1965.