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 II)

MAT 402C: Complex Analysis

Unit 1. Conformal mappings, Power series representation of analytic functions, Analytic functions as mappings, Riemann sphere, Linear transformations, Mobius transformation, Cross ratios, Mobius transformation on circles.

Unit 2. Derivative of an analytic function, Higher order derivatives, Cauchy's theorem integral formula. Morera's theorem, Cauchy inequality and Liouville's theorem.

Unit 3. Counting zeros, The open mapping theorem, Maximum modulus principle, Schwarz lemma, The fundamental theorem of algebra.

Unit 4. Harmonic functions, Mean value property, Poisson formula.

Unit 5. Entire functions, Jensen's formula, Meromorphic functions.

Books Recommended:

1. *L.V. Ahlforse: Complex Analysis, Tata McGraw Hill.*
2. J.B. Conway: Functions of one Complex variable, Springer-Verlag, 1980.
3. D. Sarason: Complex Function Theory, Hindustan Book Agency, Delhi, 1994.
4. B. Choudhary: Elements of Complex Analysis, Wiley Eastern Ltd., New Delhi, 1993.

MAT 404: Abstract Algebra

Unit 1. Normal and subnormal series, Zassenhaus's lemma, Schreiers' refinement theorem, composition series, Jordan Holder theorem, chain conditions, examples. Internal and external direct products and their relationship. Indecomposability.

Unit 2. Sylow subgroups. Sylow's I, II and III theorems, p – groups, examples and applications, Groups of order p q, Direct and inverse images of Sylow subgroups.

Unit 3. Commutators. Solvable groups, solvability of subgroups and factor groups. Nilpotent groups and their equivalent charecterisations.

Unit 4. Rings, ideals, prime and maximal ideals ,quotient rings. Factorisation theory in commutative domains. Prime and irreducible elements, G.C.D. Euclidean Domains. Principal Ideal Domain. Divisor chain condition. Unique Factorisation Domains, examples and counter examples. Chinese remainder theorem for rings and P.I .D.s. Polynomial rings over domains. Eisenstein's irreducibility criterion .Unique factorisation in polynomial rings over U.F.D.s.

Unit 5. Fields, finite fields, field extensions, Galois extensions.

Books Recommended:

1. *J. Gallian: Abstract Algebra, Narosa Publication.*
2. N. Jacobson: Basic Algebra, Vol. I, Hindustan Publishing Co., New Delhi.
3. M. Artin: Algebra, Prentice Hall of India.
4. Ramji Lal: Fundamentals in Abstract Algebra, Chakra Prakashan, Allahabad, 1985.

5. I. N. Herstein: Topics in Algebra, Wiley Eastern Ltd., N.D., 1975.
6. D. S. Dummit and R. M. Foote: Abstract Algebra, John Wiley, N. Y.

MAT 406C: DIFFERENTIAL EQUATIONS

Unit 1. Existence and uniqueness of solutions of initial value problems for first order ordinary differential equations,singular solutions of first order ODEs,system of first order ODEs., General theory of homogeneous and non-homogeneous linear ODEs,variation of parameters,Sturm-Liouville boundary value problem,Green's function.

Unit 2. Formation of P.D.E.'s. First order P.D.E.'s, Classification of first order,P.D.E.'s, Complete, general and singular integrals, Lagrange's or quasi-linear equations, Integral surfaces through a given curve. Orthogonal surfaces to a given system of surfaces, Characteristic curves.

Unit 3. Pfaffian differential equations, Compatible systems, Charpit's method, Jacobi's Method. Cauchy problem for first order PDEs.

Unit 4. Linear equations with constant coefficients, Reduction to canonical forms, Classification of second order P.D.E.s.General solution of higher order PDEs with constant coefficients.

Unit 5. Method of separation of variables: Laplace, Diffusion and Wave equations in Cartesian, cylindrical and spherical polar coordinates, Boundary value problems for transverse vibrations in a string of finite length and heat diffusion in a finite rod.

Books Recommended:

1. *D.P. Choudhary and H. I. Freedman: A Course in Ordinary Differential Equations, Narosa Publishing House, New Delhi,2002.*
2. *E.A. Coddington: AN Introduction to Ordinary Differential Equations, Prentice Hall of India, New Delhi,1968.*
3. *I. N. Sneddon: Elements of Partial Differential Equations, McGraw-Hill, 1957*
4. *T. Amaranath: An Elementary Course in Partial Differential Equations, Narosa Publishing House, New Delhi, 2005.*
5. *Erwin Kreyszig: Advanced Engineering Mathematics, John Wiley &SON Inc., New York, 1999.*