

University of Venda
School of Mathematical and Natural Sciences
Department of Mathematics and Applied Mathematics

Honours Degree Course Content

MAT 5530 : Numerical Solution of ODEs

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Initial Value Problems for ODEs. Boundary Value Problems for ODEs.

MAT 5532 : Functional Analysis

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Metric spaces, Banach spaces, Hilbert spaces. Fundamental theorems for normed and Banach spaces. Banach's Fixed Point Theorem. Approximation theorem. Spectral theory of linear operators in normed spaces. Spectral theory of bounded self – adjoint operators

MAT 5533 : Calculus of Variations

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
The fundamental problem of calculus of variation. Euler differential equation. Euler Poisson equation. Ostradisky problem. Brachistochrone equation. Trasversalty condition. Extrema conditions. Jacobi condition. Legendre condition. Weierstrass condition. Canonical forms. Direct methods. Ritz method. Kantorovich method. Applications.

MAT 5534 : Algebra I

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Exact sequences of modules, Projective and injective modules, Simple and semi –simple modules, An outline of Homology theory, Tensor product of modules, Simple and Primitive Rings, The Jacobson Radical, Semi-simple rings, The Prime Radical and the Prime/Semi-prime rings.

MAT 5536 : Complex Analysis

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
To be selected from the following topics: Conformal mappings. Singularities, Harmonic functions, Entire functions. Analytic function continuation. Asymptotic methods. Laplace transform and application.

MAT 5537 : Measure and Integration Theory

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Set theory, rings, sigma-rings, fields, sigma-fields, Borel measure, measure, outer measure. Caratheodory, extension procedure for measures on a ring. Measurable functions. Lebesgue measure on a real line. Lebesgue integrals. Convergence Theorems. Fatou's Lemma and Fubini's theorem.

MAT 5538 : Number Theory I

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Divisibility, Prime Number, Greatest Common divisors and Prime factorization, Congruences,
Multiplicative Functions, Primitive Roots, Quadratic Residues, Decimal Fractions and Continued
Fractions and Nonlinear Diophantine equations.

MAT 5540 : Matrix analysis

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Eigenvalues, eigenvectors and similarity. Unitary equivalence and normal matrices. Canonical
forms. Hermitian and symmetric matrices. Matrix norms. Location and perturbation of matrices.
Positive definite Matrices

MAT 5541 : Stochastic Differential equations I

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Preliminaries. Ito integrals. Ito processes and Ito formula. Stochastic Differential Equations

MAT 5543 : Fluid mechanics

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Cartesian tensors, *Conservation* laws, Incompressible flow, properties of fluid flows, small
disturbance theory, shallow water theory, Compressible flow. Shock waves

MAT 5544 : Combinatorics I

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Introduction to combinatorics and the pigeonhole principle, permutations and combinations,
binomial coefficients and combinatorial identities, the principle of inclusion and exclusion,
recurrence relations and generating functions.

MAT 5549 : Partial Differential Equations

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Sturm-Liouville Problems and eigenfunction expansion. Elliptic Equations: basic properties,
maximum principle, Green's identities, separation of variables. Green's Functions and Integral
Representations: Dirichlet problem, Neumann's function in the plane, heat kernel. Variational
Methods: calculus of variations, function spaces and weak formulation.

MAT 5551 : Theory of Computer Algebra

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Introduction to cryptography, codes and computer algebra, fundamental algorithms, Euclidean
algorithms and applications of Euclidean algorithms.

MAT 5552 : Partition Theory I

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Elementary Theory of Partitions, Inversions in permutations and q – identities, Infinite series
generating functions, Restricted partitions and permutations.

MAT 5630 : Numerical Solution of Partial Differential Equations

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school

Elliptic boundary value problems, finite differences; Parabolic initial boundary value problems, finite differences; hyperbolic Partial Differential Equations

MAT 5632 : General Topology

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Basic set theory. Topological spaces and their construction. Continuous functions.
Connectedness, compactness. Separation axioms. Urtsohn's Lemma. Tychonoff theorem. Stone-Cezh Compactification. Metrizable spaces.

MAT 5633 : Integral Equations

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Integral equations of Fredholm's type. Fredholm's Theorems. Solvability. Systems of integral equations. Equations with degenerate kernels. Equations with symmetric kernels. The resolvent. Equations involving weak singularities. Singular equations. Equations of Volterra type. Integral equations of the first kind.

MAT 5634 : Transformation Geometry

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Isometries and similarity transformations in Euclidean plane and Euclidean space. Preservation properties of isometries. Existence and classification of isometries in the Euclidean plane. Application to concepts and problems in geometry, physics and modern algebra and to the analysis of congruence and similarity.

MAT 5636 : Algebra II

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Finite groups, simple and non-simplicity tests. The group generator, group classification, dihedral groups and mirrors. Symmetry groups; Lei groups with applications to differential equations. Crystallographics groups with examples from Solid State Physics.

MAT 5641 : Financial Mathematics

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Topics will be chosen from the following: Expectation pricing. Arbitrage pricing. Expectation vs. arbitrage. Discrete processes. Stochastic calculus. Ito calculus. Change of measure-the C-M-G theorem. Martingale representation theorem. Construction strategies. Blackl-Scholes model. Black-Scholes action. Pricing market securities. Interest rates. Bigger models.

MAT 5643 : Graph Theory

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Structure of graphs, trees and connectivity, Eulerian and Hamilton graphs, planar graphs, graph embeddings, graph colorings and factorizations, subgraphs and degree sequence

MAT 5644 : Combinatorics II

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Numbers, Powers and logarithms, Sums and products, Integer functions, Harmonic numbers, Fibonacci numbers, Bernoulli numbers and sequences, analysis of algorithm, Euler summation formula and asymptotic approximations.

MAT 5646 : Topics in Stability and Optimization

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Liapunov's stability theory. Pontryagin's theorem.

MAT 5650 : Number Theory II

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Introduction to combinatorics and the pidgeonhole principle, permutations and combinations, binomial coefficients and combinatorial identities, the principle of inclusion and exclusion, recurrence relations and generating functions.

MAT 5652 : Partition Theory II

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Partition Identities, Jacobi's triple product, Gaussian polynomials and inversions, representation of numbers as sums of squares, Engel's expansion.

MAT 5653 : Control Theory

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school
Introduction to control theory: examples; continuous-time systems, discrete-time systems. Linear control systems; controllability, observability, and polynomials; linear feedback, state observers, realization of constant systems, discrete-time systems. Optimal control; Performance indices. Variational methods. Potryagin's principle. Linear regulator.

MAT 5654 : Stochastic Differential Equations II

Prerequisite(s) : As per the departmental requirements subject to admission rules of the school

MAT 5701 : Project

The research project shall be based on individual effort in the preparation of the research proposal and carrying out of the actual research with the assistance of a qualified member of staff. The research shall be done on any topic of interest picked up from either pure mathematics or applied mathematics.