Ze Yuan

Mathematics Coursework Transcript *Fall 2021 - Spring 2025*

National University of Singapore

5.0/5.0 **MA3264**, *Mathematical Modellng*, Fall 2022, Brett McInnes

4.5/5.0 **MA5205**, *Graduate Analysis I*, Fall 2022, Seng-Kee Chua
Measurable functions, Lebesgue integration and differentiation, L^p-spaces, Approximation of the identity and maximal functions, Abstract integration.
Reference: *Measure and Integral* by Richard L. Wheeden.

4.0/5.0 **MA5210**, *Differentiable Manifolds*, Fall 2022, Hung Yean Loke
Manifolds and vector bundles, almost complex structure and integrability, sheaf cohomology and calculation via resolutions, intro to Hermitian differential geometry, Chern classes.
Reference: *Differential Analysis on Complex Manifolds* by Raymond O. Wells.

4.0/5.0 **MA5219**, *Logic and Foundation of Mathematics I*, Fall 2022, Chieu-Minh Tran
Structures and Languages, the completeness theorem, Presburger arithmetic, quantifier elimination, computability, decidability, Gödel's first and second incompleteness theorems.

4.5/5.0 **MA3265**, *Introduction to Number Theory*, Spring 2023, Heng Huat Chan
Intro to elementary number theory. Multiplicative functions, the Bertrand postulate, congruence equations and primitive roots, quadratic reciprocity law, Jacobsthal sums, binary quadratic form and its class groups, continued fractions and Pell's equations.

4.0/5.0 **MA4229**, *Fourier Analysis and Approximation*, Spring 2023, Seng-Kee Chua
Fourier analysis: Fourier series, pointwise, absolute and uniform convergence, Cesàro means and Abel means, solving differential equations, Sturm-Liouville problems. Approximation theory: approximation in normed spaces, uniform approximation, Chebyshev polynomials.
Reference: *Fourier Series and Boundary Value Problems* by James Brown and Ruel Churchill. and *Introductory functional Analysis with Applications* by Erwin Kreyszig.

4.5/5.0 **MA4255**, *Numerical Methods in Differential Equations*, Spring 2023, Timo Sprekeler
ODEs: Picard's theorem, general theory of one-step methods and linear multi-step methods, Stiff problems. PDEs: Sobolev spaces, theory of FD (Finite Difference) schemes, FD approximation of elliptic and parabolic problems.

4.0/5.0 **MA5216**, *Differential Geometry*, Spring 2023, Fei Han
Riemannian metrics, connections, curvatures and related equations, warped products, metrics on Lie groups, Riemannian submersion, de Rham cohomology, basic Chern-Weil theory.
Reference: *Riemannian Geometry* by Peter Petersen. *Lectures on Chern-Weil Theory and Witten Deformations* by Weiping Zhang.

5.0/5.0 **DSA5102**, *Foundations of Machine Learning*, Fall 2023, Yi Rui Low
Supervised learning: linear models, kernel methods, support vector machines, dicision trees, model ensambling, neural networks. Unsupervised learning: PCA, clustering and Gaussian mixture models. Reinforcement leraning: MDP, Bellman's optimality condition.

4.5/5.0 **MA4203**, *Galois Theory*, Fall 2023, Kai Meng Tan
Algebraic, normal, separable and Galois extensions, finite and cyclotomic fields, radical extensions and solvability, solving polynomials by radicals, some geometric constructions, algebraic closed fields.

3.5/5.0 **MA5218**, *Representations Theory*, Fall 2023, David Hansen
Maschke's theorem and Schur's lemma, character theory, induced representation and Frobenius reciprocity, Gelfand pair, representation theory of S_n, Burnside's lemma, Frobenius group.

4.5/5.0 **MA5253**, *Riemann Surfaces*, Fall 2023, Fei Han
Complex tori, meromorphic functions and forms, divisors, holomorphic line bundles, Čech cohomology, Dolbeault theorem, Hodge theory, Serre duality, Riemann-Roch theorem.

5.0/5.0 **MA4198**, *Capstone Project*, Spring 2024, Hung Yean Loke
Capstone project on quaternion algebas with a written report.

5.0/5.0 **MA4263**, *Introduction to Analytic Number Theory*, Spring 2024, Heng Huat Chan
Arithmetic functions and Dirichlet products, average of arithmetic functions, Chebyshev's estimate, Merten's estimates, Bertrand's postulate, the prime number theorem, Dirichlet series, primes in arithmetic progression, intro to sieves.

4.5/5.0 **MA5204**, *Commutative and Homological Algebra*, Spring 2024, David Hansen
Rings and ideals, localization of rings and modules, Cohen–Seidenberg theory, Noetherian and Artin rings, DVRs and Dedekind domains, completion and Artin-Rees lemma, demension theory. fundamental lemma of HA, Ext and Tor functors, dimension shifting, minimal free resolutions, Auslander–Buchsbaum formula, regular, Gorenstein and Cohen-Macaulay rings.

4.5/5.0 **MA5209**, *Algebraic Topology*, Spring 2024, Charmaine Sia
Singular homology, excision, Eilenberg-Steenrod axioms, cellular homology, universal coefficient theorem, Künneth theorem, similar results for cohomology, cup product and cap product, fundamental group and Van Kampen theorem, covering spaces and Galois correspondence.

4.0/5.0 **MA5211**, *Lie Theory*, Spring 2024, Cheng-Bo Zhu
Connected Lie (sub)groups and Lie (sub)algebras, compact Lie groups and Lie algebras, the Killing form, representation theory of compact groups, Peter-Weyl Theory, SU(2) and $\mathfrak{sl}(2,\mathbb{C})$, root space decomposition, theorem of highest weight, Weyl's integration formula.

5.0/5.0 **MA5202**, *Number Theory*, Fall 2024, Lei Zhang
Dedekind Domain, class group and integral basis, prime decomposition, unit theorem, distribution of ideals, Dedekind zeta function, class number formula, Dirichlet L-series and Dieichlet Theorem, Adeles and Ideles.
Reference: *Number Fields* by Daniel A. Marcus. *Algebraic Number Theory* by Jürgen Neukirch.

5.0/5.0 **MA5217**, *Graduate Complex Analysis*, Fall 2024, Tien-Cuong Dinh
Residue theory, argument principle and Rouché's theorem, opem mapping theorem and maximum principle, winding numbers, conformal mappings and Möbius transformations, Riemann mapping theorem, harmonic functions, analytic continuation.
Reference: *Complex Analysis* by Lars Ahlfors.

5.0/5.0 **MA4273**, *Algebraic Geometry of Curves and Surfaces*, Spring 2025, Yujie Luo
Varieties and morphisms, function fields and rational maps, algebraic curves, intersection numbers, resolution of singularities, divisors, Riemann-Roch theorem.
Reference: *Algebraic Curves* by William Fulton.

Chongqing University

4.0/4.0 **MATH30301**, *Point Set Topology*, Fall 2021, Ping Zhang
Reference: *Topology* by James Munkres (chapter 1-7).

3.9/4.0 **MATH30102**, *Complex Analysis*, Fall 2021, Jiangtao Li
Standarc undergraduate course in complex analysis.

3.0/4.0 **MATH30102**, *Stochastic Processes*, Fall 2021

4.0/4.0 **MATH30102**, *Functional Analysis*, Spring 2022, Xianfeng Zhao
Banach and Hilbert spaces, linear operators, Riesz representation theorem, open mapping, closed graph and uniform boundedness, Hahn-Banach, conjugate space, weak and strong topologies, spectral theory of compact operators, Fredholm operators and index theory.

4.0/4.0 **MATH30302**, *Differential Geometry*, Spring 2022, Hongliang Shao
Local theory of curves and surfaces, the first and second fundamental form, vector fields, ruled surfaces and minimal surfaces, Gauss's theorema egregium, parallel transport and geodesics, the Gauss-Bonnet theorem and applications.
Reference: *Differential Geometry of Curves and Surfaces* by Manfredo P. do Carmo

3.3/4.0 **MATH30211**, *Abstract Algebra*, Spring 2022, Zhiqiang Li
Reference: *Contemporary Abstract Algebra* by Joseph A. Gallian (part 1-4).

3.8/4.0 **MATH40321**, *Algebraic Topology*, Spring 2022, Ping Zhang
Reference: *Algebraic Topology* by Allen Hatcher (chapter 0-2).