

Course Outline for MATH 5041, Transition to Graduate Mathematics

MATH 5041 Transition to Graduate Mathematics (3 units)

Prerequisite: Graduate standing.

Interactive construction and analysis of mathematical proof and exposition at the graduate level. Concepts drawn from standard advanced material in real analysis, linear algebra, and modern algebra. Repeatable up to 6 units. 1 lecture, 2 seminars. Formerly MATH 548.

Course Learning Objectives	
1	Construct rigorous proofs using the major theorems in group and ring theory.
2	Construct rigorous proofs in finite dimensional linear algebra using the ideas of basis, dimension, independence, span, and eigenvectors as well as major theorems.
3	Construct rigorous proofs for functions of one real variable using the ideas of limits, continuity, uniform continuity and differentiability along with major theorems such as the Mean Value Theorem.
4	Construct rigorous proofs for sequences and series of real numbers and sequences and series of functions using the ideas of convergence, absolute convergence, and uniform convergence along with major theorems such as the Weierstrass M-test.
5	Construct rigorous proofs using various equivalent definitions of the Riemann integral and its properties.

Expanded Course Content

Textbooks, materials, and/or other resources
1. Linear Algebra, Fifth Edition, by Friedberg, Insel, and Spence
2. Contemporary Abstract Algebra, Ninth Edition, by Joseph Gallian
3. Understanding Analysis, Second Edition, by Stephen Abbott

Week	Readings	Topics of Discussion
1	Linear Algebra Sections 1.2 – 1.6	Vector spaces, subspaces, bases, dimension, direct sums

Week	Readings	Topics of Discussion
2	Linear Algebra Sections 2.1 – 2.5	Linear transformations, null spaces and ranges, the matrix representation of a linear transformation, change of bases
3	Linear Algebra Sections 5.1 – 5.2	Eigenvalues and eigenvectors, diagonalizability
4	Contemporary Algebra Chapters 1 - 4	Groups, subgroups, Lagrange's Theorem, dihedral groups, cyclic groups
5	Contemporary Algebra Chapters 5 - 6	Symmetric groups, alternating groups, group homomorphisms, group automorphisms, Cayley's Theorem
6	Contemporary Algebra Chapters 7 - 10	Lagrange's Theorem, direct products, normal subgroups and quotient groups, the First Isomorphism Theorem
7	Contemporary Algebra Chapters 12 - 15	Rings, fields, ideals, prime ideals and maximal ideals, principal ideal domains
8	Contemporary Algebra Sections 16 - 18	Polynomial rings, factorization of polynomials, the Division Algorithm, Euclidean domains, irreducible and prime elements, unique factorization domains
9	Understanding Analysis Sections 1.3 – 1.4, 3.2 – 3.3	Axiom of completeness, consequences of completeness, open and closed sets, compact sets
10	Understanding Analysis Sections 2.2 – 2.6	The limit of a sequence, the Monotone Convergence Theorem, the Bolzano-Weierstrass Theorem, the Cauchy Criterion
11	Understanding Analysis Sections 4.2 – 4.5	Functional limits, continuous functions, the Intermediate Value Theorem
12	Understanding Analysis Sections 5.2 – 5.3	Differentiable functions, the Mean Value Theorem
13	Understanding Analysis Sections 6.2 – 6.5	Sequences and series of functions, pointwise versus uniform convergence, Weierstrass M-test

Week	Readings	Topics of Discussion
14	Understanding Analysis Sections 7.2 – 7.5	The Riemann integral, the Fundamental Theorem of Calculus
15	To be determined using previous assessments	To be determined using previous assessments

Method of Assessment

The possible methods of assessment are written individual examinations, quizzes, in-class worksheets and presentations, projects, and homework. One or more midterms and a cumulative final exam are required.

Instructional Mode

The instructional mode for this class is face-to-face. This designation means that the essential academic standards of the course require in-class student engagement, and thus remote instruction is not appropriate.