Department of Mathematics
The Ohio State University

2000-2001 Mathematics Courses

Course Number	Course Title
50	Pre-College Mathematics I
75	Pre-College Mathematics II
76	Reentry Precollege Math
103	Enrichment of Basic College Mathematics
104	Basic College Mathematics
105	Fundamental Mathematics Concepts for Teachers I
106	Fundamental Mathematics Concepts for Teachers II
107	Topics in Mathematics for Elementary Teachers
116	Excursions in Mathematics
117	Survey of Calculus
130	Math Analysis for Business I
131	Mathematical Analysis for Business II
132	Mathematical Analysis for Business III
140	Calculus with Review I
141	Calculus with Review II
148	Algebra and Trigonometry and Their Applications
150	Elementary Functions
151	Calculus and Analytic Geometry
152	Calculus and Analytic Geometry
153	Calculus and Analytic Geometry
188	Invitation to Actuarial Science
254	Calculus and Analytic Geometry
151A	Calculus and Analytic Geometry
152A	Calculus and Analytic Geometry
153A	Calculus and Analytic Geometry
151C	Calculus and Analytic Geometry
152C	Calculus and Analytic Geometry
153C	Calculus and Analytic Geometry
254C	Calculus and Analytic Geometry
161	Accelerated Calculus with Analytic Geometry
162	Accelerated Calculus with Analytic Geometry
263	Accelerated Calculus with Analytic Geometry
161G	Accelerated Calculus with Analytic Geometry I

Course Number	Course Title
162G	Accelerated Calculus with Analytic Geometry II
263G	Accelerated Calculus with Analytic Geometry III
161H	Accelerated Calculus with Analytic Geometry
162H	Accelerated Calculus with Analytic Geometry
263H	Accelerated Calculus with Analytic Geometry
190H	Elementary Analysis I
191H	Elementary Analysis II
264H	Elementary Analysis III
255	Differential Equations and Their Applications
345	Foundations of Higher Mathematics
366	Discrete Mathematical Structures I
414	Group Studies: Differential Equations for Engineering Applications
415	Ordinary and Partial Differential Equations
487H	Advanced Problem Solving
187H	Advanced Problem Solving
504	History of Mathematics
507	Advanced Geometry
510.01	Topics in Mathematics for Elementary School Teachers
510.02	Topics in Mathematics for Elementary School Teachers
210.03	Topics in Mathematics for Elementary School Teachers
512	Partial Differential Equations and Boundary Value Problems
513	Vector Analysis for Engineers
514	Complex Variables for Engineers
520H	Linear Algebra Differential Equations Complex Analysis
521H	Linear Algebra Differential Equations Complex Analysis
522H	Linear Algebra Differential Equations Complex Analysis
530	Probability
532	Mathematical Foundations of Actuarial Science
540H	Geometry and Calculus in Euclidean Spaces and on Manifolds I
541H	Geometry and Calculus in education Spaces and on Manifolds II
547	Introductory Analysis I
548	Introductory Analysis II
549	Introductory Analysis III
551	Vector Analysis
552	Introduction to the Theory of Functions of a Complex Variable
556	Differential Equations I
557	Differential Equations II
560	Point-Set Topology
566	Discrete Mathematical Structures II
568	Introductory Linear Algebra I

Course Number	Course Title
569	Introductory Linear Algebra II
571	Linear Algebra for Applications I
572	Linear Algebra for Applications II
573	Elementary Number Theory
574	Geometry
575	Combinatorial Mathematics & Graph Theory
576H	Number Theory Through History I
577H	Number Theory Through History II
578	Discrete Mathematical Models
580	Algebra I
581	Algebra II
582	Algebra III
588	Practicum in Actuarial Science
590H	Algebraic Structures I
591H	Algebraic Structures II
592H	Algebraic Structures III
601	Mathematical Principles in Science I
602	Mathematical Principles in Science II
603.02	Mathematical Principles in Science III, B
618	Theory of Interest
630	Actuarial Mathematics I
631	Actuarial Mathematics II
632	Actuarial Mathematics III
650	Principles of Mathematical Analysis
651	Introduction to Real Analysis I
652	Introduction to Real Analysis II
653	Introduction to Real Analysis III
655	Elementary Topology I
656	Elementary Topology II
657	Elementary Topology III
670	Algebra I
671	Algebra II
672	Algebra III

Mathematics 075 **4 cr.** **Precollege Mathematics II**
A, W, Sp, Su

Prerequisite:

Mathematics 050, or Course Code S or R on Math Placement Test.

Catalog Description:

Systems of equations, arithmetic of polynomials, factoring, fractional equations, variation, quadratic equations, functions, graphs, right angle trigonometry.

Purpose of Course:

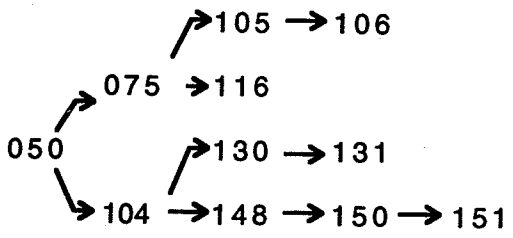
To meet the needs of students entering the University with Course Code S on Math Placement Test, or with credit for 050. Completion of Math 075 is required for entry into numerous degree granting colleges; however, credit for 075 will not count toward graduation in any degree granting program. It is designed for students continuing in Math 105 or 116.

Follow-up Courses:

Math 104 for students switching to science, computer science, business or engineering curriculum.

Math 116 for students in liberal arts or students in the precertification programs on regional campuses.

Sequencing Chart:



Text:

Beginning Algebra, (2nd ed.) Martin-Gay

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(Over for Topics List & Sample Syllabus)

Topics List & Sample Syllabus

Sections	Topics
5.5	FACTORING STRATEGIES FOR POLYNOMIALS
6.1–6.8	RATIONAL EXPRESSIONS Simplifying rational expressions Multiplying and dividing rational expressions Adding and subtracting rational expressions Least common denominator Simplifying complex fractions Solving rational equations Ratio and proportion Rational equations and problem solving
	Review and first midterm
3.4, 7.1, 7.2	LINEAR EQUATIONS Slope Slope-intercept form Point-slope form
8.1–8.4	SYSTEMS OF LINEAR EQUATIONS Solving systems of linear equations by graphing Solving systems of linear equations by substitution Solving systems of linear equations by elimination Systems of linear equations and problem solving Systems of linear inequalities
3.5, 8.5	LINEAR EQUATIONS Graphing linear inequalities Systems of linear inequalities
	Review and second midterm
9.1–9.7	ROOTS AND RADICALS Introduction to radicals Simplifying radicals Adding and subtracting radicals Multiplying and dividing radicals Solving equations containing radicals Radical equations and problem solving Rational exponents
10.1–10.4	QUADRATIC EQUATIONS Solving quadratic equations by the square root method Solving quadratic equations by completing the square Solving quadratic equations by the quadratic formula
	Review and third midterm
10.5	COMPLEX SOLUTIONS OF QUADRATIC EQUATIONS
	Review and final exam

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Course Coordinator:
Brian McEnnis
2000-2001

Mathematics 104 **5 cr.** **Basic College Mathematics**
A, W, Sp, Su

Prerequisite:

Mathematics 050, or 075, or Course Code R on Math Placement Test. Not open to students with credit for 116, 130, or 148.

Catalog Description:

Systems of equations, arithmetic of polynomials, rational expressions, factoring, fractional equations, inequalities, exponents, quadratic equations, absolute values, functions and graphs.

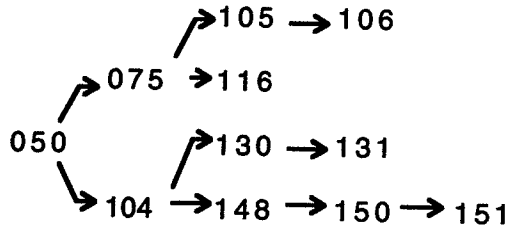
Purpose of Course:

To meet the needs of students entering the University with Course Code R or with credit for 050 who need to complete Math 130 or 148. Completion of Math 104 is required for entry into some degree granting colleges.

Follow-up Course:

Math 130 or 148.

Sequencing Chart:



Text:

Essentials of Intermediate Algebra-Graphs and Functions, 2nd edition-OSU Version, Larson, Hostetler, and Neptune.

(Over for Topics List and Sample Syllabus)

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Topics List & Sample Syllabus

Sections	Topics
1.3-1.8;OSU.2	ALGEBRAIC EXPRESSIONS Operations with Polynomials Factoring Polynomials Factoring Trinomials Solving Linear Equations Solving Equations by Factoring Additional Exercises in Literal Equations
2.2,2.4,2.5	GRAPHS OF EQUATIONS Relations and Functions Functional Notation Graphs of Functions
	Review and 1st Midterm
2.3,3.1,3.3-3.5	SLOPE: AN AID TO GRAPHING LINES Writing Equations of Lines Applications of Linear Equations Business and Scientific Problems Linear Inequalities in One Variable
4.1,5.1,5.2	SYSTEMS OF LINEAR EQUATIONS IN TWO VARIABLES Integer Exponents and Scientific Notation Rational Exponents and Radicals
	Review and 2nd Midterm
5.3-5.5,6.1-6.5	SIMPLIFYING AND COMBINING RADICALS Multiplying and Dividing Radicals Solving Radical Equations The Factoring and Square Root Methods Completing the Square The Quadratic Formula and the Discriminant Applications of Quadratic Equations Graphing Quadratic Functions
	Review and 3rd Midterm
7.1-7.3;7.5;OSU.1	SIMPLIFYING RATIONAL EXPRESSIONS Multiplying and Dividing Rational Expressions Addition and Subtraction of Rational Expressions Solving Rational Equations Applications of Rational Equations

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Course Coordinator:
Paul Ponomarev
2000-2001

Mathematics 050 **5 cr.** **Precollege Mathematics I**
A, W, Sp, Su

Prerequisite:

Course Code T on Math Placement Test.

Catalog Description:

Arithmetic of fractions and decimals, basic algebra, graphing equations, geometry, exponents, applications of exponents, lines and slopes, area.

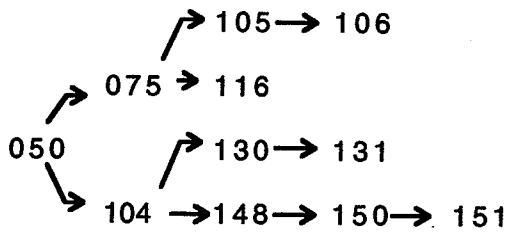
Purpose of Course:

Mathematics 050 is designed to meet the needs of the students entering The Ohio State University at the lowest placement, course code T. This course will prepare students for 075 or 104. Math conditions are removed by completion of 050, 075 or 050, 104.

Follow-up Course:

Math 075 or Math 104

Sequencing Chart:



Text:

Beginning Algebra by K. Elayn Martin-Gay, 2nd ed.

(Over for Topics List and Sample Syllabus)

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Topics List & Sample Syllabus

Sections	Topics
1.1-1.7	REVIEW OF REAL NUMBERS
	Symbols and Sets of Numbers
	Fractions
	Exponents and Order of Operations
	Introduction to Variable Expressions and Equations
	Adding Real Numbers; Subtracting Real Numbers
	Multiplying and Dividing Real Numbers
2.1-2.9	EQUATIONS, INEQUALITIES, AND PROBLEM SOLVING
	Simplifying Algebraic Expressions
	The Addition and Multiplication Property of Equality
	Solving Linear Equations
	An Introduction to Problem Solving
	Formulas, Percent and Problem Solving
	Further Problem Solving
	Solving Linear Inequalities
	Review and 1st Midterm
1.9, 3.1-3.4	GRAPHING
	Reading Graphs
	The Rectangular Coordinate System
	Graphing Linear equations
	Intercepts; Slope; Graphing Linear Inequalities
4.1-4.6	EXPONENTS AND POLYNOMIALS
	Exponents
	Addition and Subtraction of Polynomials
	Multiplication of Polynomials, Special Products
	Review and 2nd Midterm
	Negative Exponents and Scientific Notation
	Division of Polynomials
5.1-5.7	FACTORING POLYNOMIALS
	The Greatest Common Factor and Factoring by Grouping
	Factoring Trinomials
	Factoring Binomials
	Choosing a Factoring Strategy
	Review and 3rd Midterm
	Solving Quadratic Equations by Factoring
	Quadratic Equations and Problem Solving
	Review and Final Exam

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Course Coordinator:
Lee McEwan
2000-2001

Mathematics 076 **4 cr.** **Reentry Precollege Math**
A, W, Sp, Su

Prerequisite:

At least one year of high school algebra, out of high school for 5 or more years at time of university enrollment, no formal training in Math in the past 5 years, and written permission of the Department of Mathematics.

Catalog Description:

Arithmetic of signed numbers, exponents, linear equations, systems of equations, arithmetic of polynomials, factoring, fractional equations, variation, quadratic equation, functions, graphs.

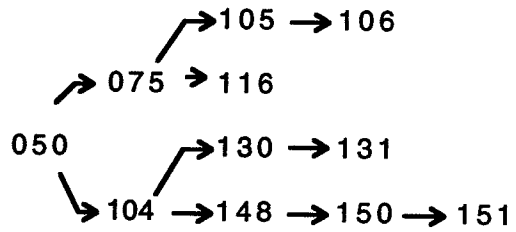
Purpose of Course:

This course is designed to meet the needs of returning, non-traditional students. It can be considered a substitute for 050 and 075 and satisfies the prerequisites for Math 104, 105, and 116. Completion of Math 076 is sufficient for entry into numerous degree granting colleges; however, credit for 076 will not count toward graduation in any degree granting program.

Follow-up Courses:

Math 104 for students in science, computer science, business, or engineering.
Math 105 for students in some education and human ecology programs.
Math 116 for students in liberal arts.

Sequencing Chart:



Text:

Algebra, An Approach for Success, Damarin and Leitzel, (Burgess International Group, Inc.)
Chapters 1 - 6, 8 - 11

(Over for Topics List)

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Topics List

1. Arithmetic of signed numbers

2. Exponents
   integral exponents and rational exponents (numerically)
   laws of exponents
   simplification of exponential expressions

3. Word problems

4. Solving linear equations and inequalities

5. Graphs of equation

6. Linear equations
   standard form; slope - intercept form

7. Parallel and perpendicular lines

8. Systems of linear equations

9. Polynomials
   addition, subtraction, multiplication
   division with quotient and remainder

10. Factoring polynomials
    common monomial factor
    quadratics
    by grouping

11. Rational roots and factors

12. Fractional exponents

13. Simplifying radical expressions

14. Solving quadratic equations
    by factoring
    by completing the square
    use of quadratic formula

15. Negative exponents

16. Simplifying rational expressions

17. Solution of fractional equations and applications

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Course Coordinator:
Gloria Woods
2000-2001

Mathematics 103 **2 cr.** **Enrichment of Basic**
Au **College Mathematics**

Catalog Description:

Supplement to Math 104 using small group interaction and active learning to enhance the development of skills necessary to succeed in 104 subsequent courses.

This course ran under the 194A course number from Au 94 to Au 97.

Prerequisite:

New first quarter freshman, no math admission condition, and Math Placement T or S; concur 104.

Purpose of Course:

This course offers a supplement for Course Code T and S students using interactive learning. Enrollment in 103 enables these students to concurrently enroll in Math 104, instead of 050. Math 103 was offered in Au 94, Au 95, Au 96, and Au 97 under the Math 194A course number.

Follow-up course:

Students in 103 who also successfully complete 104 are then eligible for 116, 130 or 148.

Text:

Materials as chosen by instructor or Course Coordinator.

Topics:

Topics are chosen to supplement the students' background for material they will study in 104.

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Course Coordinator:
Harry Allen
2000-2001

Mathematics 105 **5 cr.** **Fundamental Mathematics**
A, W **Concepts for Teachers I**

Prerequisite:

Mathematics 075 or 104, or Course Code L, M, N or R on Math Placement Test. Math 105N is open only to Rank 4 and GRD EDU students, and to students who have applied to the M. Ed program.

Catalog Description:

Development of basic ideas of arithmetic, algebra, and geometry as appropriate for teachers.

Purpose of Course:

To develop an appreciation of, and basic competency in, the use of analytical thought in the development of a cohesive body of useful mathematical knowledge, with special emphasis on topics encountered in elementary and middle school mathematics programs. Math 105 deals with the whole number system, measurement, and combinatorial counting techniques. Math 106 introduces rational numbers and integers, congruent and similar triangles, and probability.

Follow-up Course:

Math 106

Text:

Mathematics for Elementary Teachers, 5th Ed., Musser & Burger;
OSU Math 105 Supplements/Labs

Topics & Sample Syllabus:

Sections	Topics
2.1, 2.2, 2.3	The number concept/counting
Supp. A, 13.2	Measurement with whole numbers
3.1, 3.3, 4.2	Addition and subtraction of whole numbers
Supp. B1-B4	Addition and subtraction in measurement
3.2,3.3,4.2,Supp B5	Multiplication and division of whole numbers
Supp. B6, 13.2	Measurement using whole number arithmetic
13.3, 13.4	Surface area and volume
11.2, 11.3	Counting techniques
5.1, 5.2	Number Theory

Course Coordinator:
Joe Ferrar,
2000-2001

Mathematics 106 **5 cr.** **Fundamental Mathematics**
Wi, Sp **Concepts for Teachers II**

Prerequisite:

Mathematics 105 or written permission of the department. Math 106N is open only to Rank 4 and GRD EDU students, and to students who have applied to the M. Ed program.

Catalog Description:

Continuation of 105.

Purpose of Course:

To develop an appreciation of, and basic competency in, the use of analytical thought in the development of a cohesive body of useful mathematical knowledge, with special emphasis on topics encountered in elementary and middle school mathematics programs. Math 105 deals with the whole number system, measurement, and combinatorial counting techniques. Math 106 introduces rational numbers and integers, congruent and similar triangles, and probability.

Follow-up Course:

Math 107

Text:

Mathematics for Elementary Teachers, 5th ed., Musser & Burger.

and

OSU Math 106 Supplements/Labs

Topics & Sample Syllabus:

Sections	Topics
6.1, 6.2, 6.3	Fractions
7.3, 11.1	Ratios/Probability
11.2, 11.4	More Probability
7.1, 7.2, 7.4	Decimals and percent
8.1, 8.2	Integers
9.1, 9.2	Rational and real numbers
Supp. C1-C5, 14.1	Deductive geometry
Supp. C6, 14.2, 14.3	Similar triangles/constructions
15.1, 15.2	Coordinate geometry

Note: Math 106 students will be expected to know and be able to apply basic area and volume formulas and concepts as covered in Math 105.

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Course Coordinator:
Joe Ferrar
2000-2001

Mathematics 107 **5 cr.** **Topics in Mathematics**
Sp **For Elementary Teachers**

Prerequisite:

Mathematics 106

Catalog Description:

Further topics in mathematics selected by the instructor to broaden the mathematics perspectives of elementary teachers.

Topics:

Optional with instructor. Should closely relate to content of 105 and 106 and serve to tie together topics previously encountered. A problem-solving approach using microcomputers is highly appropriate.

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Course Coordinator:
Joe Ferrar
2000-2001

Mathematics 116 **5 cr.** **Excursions in Mathematics**
***A, W, Sp, Su**

*(*Offered in Autumn on regional campuses only.)*

Prerequisite:

Mathematics 075 or 076 or 104 or course code R on Math Placement Test.

Catalog Description:

Critical thinking & problem solving, with relevant topics met in everyday life; appropriate for majors in the non-physical sciences.

Purpose of Course:

The emphasis in this course is on intuitive understanding and developing some facility for applying mathematical ideas to problem solving.

Follow-up Courses:

None. Math 116 is a terminal course.

Text:

For All Practical Purposes: Mathematical Literacy in Today's World, COMAP, 5th ed., W.H. Freeman, 2000.

(Over for Topics List)

Topics List

Chapters	Topics
Ch. 1	Street Networks Finding Euler circuits Circuits with reused edges Circuits with more complications
Ch. 2	Visiting Vertices Hamiltonian circuits Traveling salesman problem Strategies for solving the Traveling salesman problem Minimum cost-spanning trees Critical analysis
Ch. 4	Linear programming Mixture problems Mixture problems having one resource Mixture problems having two resources The corner point principle Linear programming: The wider picture
Ch. 10	Transmitting Information Binary codes Encoding with parity-check sums Cryptography
Ch. 16	Growth and Form Geometric similarity The language of growth, enlargement, and decrease Measuring length, area, volume, and weight Scaling real objects Sorry, no King Kongs Solving the problem of scale Falls, dives, jumps, and flights Keeping cool (and warm) Similarity and growth
Ch. 17	Symmetry and Patterns Fibonacci numbers The golden ratio Balance in symmetry Rigid motions Preserving the pattern Analyzing patterns Strip patterns Symmetry groups Notation for patterns Imperfect patterns

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Course Coordinator:
Tom Dowling
2000-2001

Mathematics 117 **5 cr.** **Survey of Calculus**
A, W, Sp

Prerequisite:

Mathematics 130 or 148 or 150

Catalog Description:

An introduction to differential and integral calculus.

Purpose of Course:

The majority of the audience is made up of Architecture majors (who will have already taken 148 and 150) for whom the course is a requirement, with the balance being Exercise Science, and Elementary Ed students doing a Math Concentration. The intent of the course is to introduce these students to the derivative and definite integral, using the slope of the tangent line or rate of change as a conceptual model for the derivative and area as a model for the definite integral. For this audience, graphical examination of these ideas is helpful.

Follow-up Courses:

There are really no follow-up courses. To start any other mathematics sequence will probably involve beginning at an appropriate entry level course. Students interested in further course work in mathematics should consult the mathematics counselors in 105 Mathematics Bldg.

Text:

Ernest F Haeussler,Jr. and Richard Paul, Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences, 9th ed.

(Over For Topics List And Sample Syllabus)

Topics List & Sample Syllabus

Sections	Topics
11.1,11.2	Limits
11.4	Continuity
11.5	Continuity Applied to Inequalities
12.1	Derivatives
12.2	Rules of Differentiation
12.3	The Derivative as a Rate of Change
12.5	Product and Quotient Rules
12.6	The Chain Rule and Power Rule
	Review and Midterm #1
13.1	Derivatives of Logarithmic Functions
13.2	Derivatives of Exponential Functions
13.5	Higher Order Derivatives
14.1	Relative Extrema
14.2	Absolute Extrema on a Closed Interval
14.3	Concavity
14.4	Second Derivative Test
15.1	Applied Maxima and Minima
	Review and Midterm #2
16.1	The Indefinite Integral
16.2	Integration with Initial Conditions
16.3	More Integration Formulas
16.4	Techniques of Integration
16.7	The Fundamental Theorem of Calculus
16.8	Area
16.9	Area Between Curves
16.10	Consumers' and Producers' Surplus
17.3	Integration by Tables
	Review and Midterm #3
17.5	Approximate Integration.

Review and Final Exam

Course Coordinator:
Surinder Sehgal
2000-2001

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Mathematics 130 **4 cr.** **Math Analysis for Business I**
A, W, Sp, Su

Prerequisite:

Mathematics 104, or Course Code M or N on Math Placement Test.

Catalog Description:

Equations, inequalities, absolute value, polynomial functions, exponential and logarithmic functions, applications to business.

Purpose of Course:

To provide students with the pre-calculus mathematics needed in the Business program. The applications are business related.

Follow-up Course:

Math 131

Text:

Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences, Haeussler & Paul, 9th ed.

Topics & Sample Syllabus

Topics	Topics
1.1, 1.2	Liner Equations, Equations Leading to Linear Equations
1.3	Quadratic Equations
2.1, 2.2	Applications of Equations, Linear Equations
2.3	Applications of Inequalities
3.1, 3.2	Functions, Special Functions
3.4	Graphs in Rectangular Coordinates
4.1, 4.2	Lines, Applications and Linear Functions
4.3	Quadratic Functions
4.4, 4.5	Systems of Linear Equations, Nonlinear Systems
4.6	Applications of Systems of Equations
5.1, 5.2	Exponential Functions, Logarithmic Functions
5.3	Properties of Logarithms
5.4	Logarithmic and Exponential Equations
8.1, 8.2	Compound Interest, Present Value
8.3, 8.4	Annuities, Amortization of Loans
7.1	Linear Inequalities in Two Variables

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Course Coordinator
Gloria Woods
2000-2001

Math 131 **4 cr.** **Mathematical Analysis for Business II**
A, W, Sp, Su

Prerequisite:

Mathematics 130 or 148 or 150, or Course Code L on Math Placement Test.

Catalog Description:

Matrices, determinants, linear programming, interpretation of graphs, modeling, applications.

Purpose of Course:
Math 131 is designed to introduce students in the College of Business to matrix algebra, calculus concepts, and related business applications. This course is problem oriented.

Text:

Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences, Haeussler & Paul, 9th ed.

Topics and Sample Syllabus

Sections	Topics
6.1	Matrices
6.2	Matrix Addition and Scalar Multiplication
6.3	Matrix Multiplication
6.4, 6.5	Method of Reduction
6.6	Inverses
6.7	Determinants
4.2, A.1	Review: Equations and Slope of Line
7.1	Linear Inequalities in Two Variables
7.2	Linear Programming
7.3	Multiple Optimum Solutions
A.2	Secant Lines, Average Rate
A.3, 12.1	Slope of a Curve
A.3, 12.3	Derivative
A.4	Area
A.5, 16.5	Summation
A.6, 16.6	Riemann Sum, Definite Integral
A.7	Area Under a Rate-of-Change Curve

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Course Coordinator
Phil Huneke
2000-2001

Math 132 **5 cr.** **Mathematical Analysis for Business III**
Au, Wi, Sp, Su

Prerequisite:

Mathematics 130 or 150

Catalog Description:

Limits, derivatives of polynomial, logarithmic, and exponential functions, sigma notation, area under curves, the definite integral, and applications to business.

Purpose of Course:

The 131 and 132 courses are designed to introduce students in the College of Business to topics in finite mathematics, modeling, and an overview of differential and integral calculus. The courses are problem oriented with emphasis on business applications

Text:

Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences, 9th edition, by Ernest Haussler/Richard S. Paul, Chapters 11-17.

Topics & Sample Syllabus

Sections	Topics
11.1, 11.2	Limits
11.5	Continuity Applied to Inequalities
12.1	Derivatives
12.2	Rules of Differentiation
12.3	The Derivative as a rate of Change
12.5	Product, Quotient Rules
12.6	Power Rule
13.1	Derivatives of Logarithmic Functions
13.2	Derivatives of Exponential Functions
13.5	Higher Order Derivatives
14.1	Relative Extrema
14.2	Absolute Extrema on a Closed Interval
14.3	Curve Sketching
14.4	Second Derivative Test
15.1	Applied Maxima and Minima
16.1	The Indefinite Integral
16.2	Integration with Initial Conditions
16.3	More Integration Formulas
16.4	Techniques of Integration
16.7	The Fundamental Theorem of Calculus
16.8	Area
16.9	Area Between Curves
16.10	Consumer Surplus and Producers Surplus
17.3	Integration by Tables
17.5.1	Approximate Integration

Course Coordinator:
Surinder Sehgal
2000-2001

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Mathematics 140 Au	**5 cr.**	**Calculus with Review I**
Mathematics 141 Wi	**5 cr.**	**Calculus with Review II**

Prerequisite:

Level N placement (i.e. placement into Math 148), 4 years of college preparatory math in high school, and some exposure to Calculus.

Catalog Description:

140: Review of polynomial and rational functions, difference quotients, limits, continuity, derivatives, chain rule, higher order derivatives, implicit differentiation, related rates.

141: Trigonometric review, differentiation of the trigonometric functions, review of exponential and logarithmic functions, mean value theorem, applications to curve sketching, applied maxima and minima problems.

Purpose:

This two quarter sequence is intended for beginning students who (i) aim at a major which requires at least through the 152 level, (ii) placed at level N (and thus would otherwise have to take three math classes to get to Math 152), and (iii) took 4 or more years of college preparatory mathematics in high school. Its purpose is to equip such students to succeed in 152 in the Spring Quarter.

Follow-up Course:

Students who succeed in both 140 and 141 are prepared for 152. Students failing either course or dropping out of the sequence at any time must meet with the math counselors for rerouting specific to their situation.

Text:

Calculus with Analytic Geometry, 5th edition, Ellis and Gulick. This is the same book as used in 151-152.

Topics:

The two courses together cover the topics in differential calculus as listed in 151. The assignments are longer and more searching than is feasible in a standard pace course. The students, thereby reinforce their mastery of algebra, analytic geometry, and trigonometry.

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Course Coordinator:
Bostwick Wyman
2000-2001

Mathematics 148 | **4 cr.** | **Algebra and Trigonometry and Their Applications**
A, W, Sp, Su

Prerequisite:

Mathematics 104, or Course Code N on Math Placement Test.

Catalog Description:

Applications from chemistry, physics, and biology which involve solving linear and quadratic equations, system of equations, variation, trigonometry of acute angles, law of sines and cosines, vectors, and exponential (resp. logarithmic) equations.

Purpose of Course:

To help students make the transition from abstract mathematics to concrete applications, while at the same time reinforcing the algebra and trigonometry skills needed to proceed with more advanced mathematics.

Follow-up Course:

Math 150 for those students needing to take Math 151

Text:

OSU Custom Text, Dwyer and Gruenwald

Technology: All students are required to have a graphing calculator.

Topics List & Sample Syllabus

Sections	Topics
1.1	Applications
1.2	Manipulating Formulas and Literal Equations
2.1	Linear Equations
2.2	Quadratic Equations
2.3	Graphs of Equations
2.4	Parabolas
2.5	Systems of Equations
3.1	Modeling with Variation
3.2	Angles and Their Measurements
3.3	Trigonometric Functions of Acute Angles
3.4	Trigonometric Functions of Obtuse Angles
3.5	The Law of Sines
3.6	The Law of Cosines
4.1	Exponential Equations
4.2	Using a Graphics Calculator to Solve Exponential Equations
4.3	Logarithms
4.4	Logarithmic Equations
4.5	Exponential Equations and Applications

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Course Coordinator:
David George
2000-2001

Mathematics 150 **5 cr.** **Elementary Functions**
A, W, Sp, Su

Prerequisite:
Mathematics 148, or Course Code M on Math Placement Test.

Catalog Description:

Inverse functions, logarithmic, exponential and trigonometric functions, and their graphs; complex numbers.

Purpose of Course:

To learn the basic aspects of the elementary functions (rational, exponential, logarithmic, and trigonometric). Most students in this course plan to take the regular calculus sequence.

Follow-up Course:

Math 151 or Math 117

Text:

Precalculus, A Graphing Approach, Barnett, Ziegler, Byleen

Technology: All students are required to have a graphing calculator. Most instructors will be familiar with the Texas Instruments TI-83.

Sections	Topics
1.3	Functions
1.4	Functions: Graphs and Properties
1.5	Functions: Graphs and Transformations
2.1	Linear Functions
2.2	Linear Equations and Inequalities
2.3	Quadratic Functions
2.5	Quadratic Equations and Inequalities
3.1	Polynomial Functions
3.2	Finding Rational Zeros of Polynomials
3.4	Rational Functions
4.1	Operations on Functions: Composition
4.2	Inverse Functions
4.3	Exponential Functions
4.4	The Exponential Function with Base e
4.5	Logarithmic Functions
4.6	Common and Natural Logarithms
4.7	Exponential and Logarithmic Equations
5.1	The Wrapping Functions
5.2	Circular Functions
5.3	Angles and Their Measure
5.4	Trigonometric Functions
5.5	Solving Right Triangles
5.6	Graphing Basic Trigonometric Functions
5.7	Graphing $y = k + A \sin(Bx + C)$ and ....
5.9	Inverse Trigonometric Functions
6.1	Basic Identities and Their Use
6.2	Sum, Difference, and Cofunction Identities
6.3	Double-Angle and Half-Angle Identities
6.5	Trigonometric Equations
7.5	Polar Coordinates and Graphs

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Course Coordinator:
David George
2000-2001

Mathematics 151 **5 cr.** **Calculus and**
A, W, Sp, Su **Analytic Geometry**

Prerequisite:

Mathematics 150 or Course Code L on Math Placement Test.

Catalog Description:

Limits, continuity, derivatives, Mean Value theorem, extrema, curve sketching, related rates, differentiation of the trig, log, and exponential functions.

Purpose of Course:

To provide students with a solid foundation in one-variable differential calculus.

Follow-up Course:

Math 152

Text:

Calculus with Analytic Geometry, Ellis and Gulick, 5th ed.

Topics & Sample Syllabus:

Sections	Topics
1.7, 1.8	Trigonometric Functions, Exponential and Logarithmic Functions
2.1	Limits and Continuity
2.2	Definition of a Limit
2.3	Limit Theorems and Continuity
2.4	The Squeezing Theorem and Substitution Rule
2.5	One-sided and Infinite Limits
2.6	Continuity on Intervals and the Intermediate Value Theorem
	Review and Midterm # 1
3.1	The Derivative
3.2	Differentiable Functions
3.3	Derivatives of Combinations of Functions
3.4	The Chain Rule
3.5	Higher Derivatives
3.6	Implicit Differentiation
3.7	Related Rates
3.8	Approximations
	Review and Midterm #2
4.1	Maximum and Minimum Values
4.2	The Mean Value Theorem
4.3	Applications of the Mean Value Theorem
4.4	Exponential Growth and Decay
4.5	the First and Second Derivative Tests
4.6	Extreme Values on an Arbitrary Interval
	Review and Midterm #3
4.7	Concavity and Inflection Points
4.8	Limits at Infinity
4.9	Graphing
	Review and Final Exam

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Course Coordinator:
Zbigniew Fiedorowicz
2000-2001

Mathematics 152 **5 cr.** **Calculus and Analytic Geometry**
A, W, Sp, Su

Prerequisite:

Mathematics 151

Catalog Description:

Integral, area, fundamental theorems of calculus, logarithmic and exponential functions, trigonometric and inverse trigonometric functions, methods of integration, applications of integration.

Purpose of Course:

To provide students with a solid foundation in one-variable integral calculus.

Follow-up Course:

Math 153

Text:

Calculus with Analytic Geometry by Ellis and Gulick, 5th ed.

(Over for Topics List & Sample Syllabus)

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Topics List & Sample Syllabus

Sections	Topics
5.1	Preparation for the Definite Integral
5.2	The Definite Integral
5.3	Special Properties of the Definite Integral
5.4	The Fundamental Theorem of Calculus
5.5	Indefinite Integrals and Integration Rules
5.6	Integration by Substitution
5.7	The Logarithm
5.8	Another Look at Area
	Review and Midterm #1
6.1	Inverse Functions
6.2	The Natural Exponential Function
6.3	General Exponential and Logarithmic Functions
6.5	The Inverse Trigonometric Functions
6.6	L'Hôpital's Rule
6.7	Introduction to Differential Equations
6.8	Methods of Solving Differential Equations
7.1	Integration by Parts
	Review and Midterm #2
7.2	Trigonometric Integrals
7.3	Trigonometric Substitutions
7.4	Partial Fractions
7.5	Integration by Tables and Symbolic Integration
7.6	The Trapezoid Rule and Simpson's Rule
7.7	Improper Integrals
8.1	Volume: The Cross-Sectional Method
8.2	Volume: The Shell Method
	Review and Midterm #3
8.3	Length of a Curve
8.4	Area of a Surface
One of the following:	
8.5	Work
8.6	Moments and Center of Gravity
8.7	Hydrostatic Force
	Review and Final Exam

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Course Coordinator:
Zbigniew Fiedorowicz
2000-2001

Mathematics 153 **5 cr.** **Calculus and Analytic Geometry**
A, W, Sp, Su

Prerequisite:

Mathematics 152

Catalog Description:

Indeterminate forms, Taylor's formula, improper integrals, infinite series, parametric curves and vectors in the plane; vectors, curves, and surfaces in space.

Purpose of Course:

To provide students with a solid foundation in calculus.

Follow-up Course:

Math 254

Text:

Calculus with Analytic Geometry by Ellis and Gulick, 5th ed.

Topics & Sample Syllabus

Sections	Topics
	SEQUENCES AND SERIES:
9.1	Polynomial Approximation
9.2	Sequences
9.3	Convergence Properties of Sequences
9.4	Infinite Series
9.5	Positive Series: The Integral Test and the Comparison Tests
9.6	Positive Series: The Ratio Test and the Root Test
9.7	Alternating Series and Absolute Convergence
9.8	Power Series
9.9	Taylor Series
9.10	Binomial Series
	CURVES IN THE PLANE:
10.1	Parametrized Curves
10.2	Length and Surface Area for Parametrized Curves
10.3	Polar Coordinates
10.4	Length and Area in Polar Coordinates
10.5	Conic Sections
	VECTORS, LINES AND PLANES:
11.1	Cartesian Coordinates in Space
11.2	Vectors in Space
11.3	The Dot Product
11.4	The Cross Product and Triple Products
11.5	Lines in Space
11.6	Planes in Space
	VECTOR-VALUED FUNCTIONS:
12.1	Definitions and Examples
12.2	Limits and Continuity of Vector-Valued Functions
12.3	Derivatives and Integrals of Vector-Valued Functions
12.4	Space Curves and Their Lengths
12.5	Tangents and Normals to Curves

Course Coordinator:
Phil Huneke
2000-2001

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Mathematics 188 **1 cr.** **Invitation to Actuarial Science**
Sp

Prerequisite:

Mathematics 151, 161, H161, or H190, or permission of instructor.

Catalog Description:

Introduction to some basic ideas of life, health, and property and casualty insurance. Presentations by practicing actuaries on aspects of the actuarial profession.

Purpose of Course:

This course introduces students to some of the ideas of actuarial science and opportunities in the actuarial profession. At least half of the course presentations will be given by practicing actuaries. We hope that this experience will help our students decide on an appropriate major.

Text:

A textbook is not used in this course.

Syllabus:

WEEK 1	Introduction to Actuarial Science. Discussion of the Major Program in Actuarial Science at Ohio State. Opportunities and expectations for careers in actuarial science and related areas.
WEEKS 2-9	Visits by practicing actuaries from local firms who will give overviews of various aspects of the profession; and talks by O.S.U. faculty from mathematics and related fields, such as statistics, risk management, finance, and economics.
WEEK 10	Course summary, student feedback, and discussions.

Grading:

A brief 1-2 page essay or the solution of a computational problem will be required each week.

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Course Coordinator:
Bostwick Wyman
2000-2001

Mathematics 254 | **5 cr.** | **Calculus and Analytic Geometry**
Au, Wi, Sp, Su

Prerequisite:

Mathematics 153

Catalog Description:

Partial differentiation, Lagrange multipliers, multiple integrals, line integrals, and Green's Theorem.

Purpose of Course:

To provide students with a solid foundation in calculus.

Text:

Calculus with Analytic Geometry, (5th ed.), Robert Ellis and Denny Gulick.

Topics & Sample Syllabus

Sections	Topics
	PARTIAL DERIVATIVES
13.1	Functions of Several Variables
13.2	Limits and Continuity
13.3	Partial Derivatives
13.4	Chain Rule
13.5	Directional Derivatives
13.6	The Gradient
13.7	Tangent Plane Approximation and Differentials
13.8	Extreme Values
13.9	Lagrange Multipliers
	MULTIPLE INTEGRALS
14.1	Double Integrals
14.2	Double Integrals in Polar Coordinates
14.3	Surface Area
14.4	Triple Integrals
14.5	Triple Integrals in Cylindrical Coordinates
14.6	Triple Integrals in Spherical Coordinates
14.7	Moments and Centers of Gravity
14.8	Change of Variables in Multiple Integrals
	CALCULUS OF VECTOR FIELDS
15.1	Vector Fields
15.2	Line Integrals
15.3	Fundamental Theorem of Line Integrals
15.4	Green's Theorem

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Course Coordinator:
Phil Huneke
2000-2001

Mathematics 151A Au
Mathematics 152A Wi
Mathematics 153A Sp

5 cr. each

Calculus and Analytic Geometry

Prerequisite:

The prerequisites are the same as those for 151, 152, 153; e.g. for 151A the prerequisite is Math 150 or satisfactory score on the mathematics placement test.

Catalog Description:

The catalog descriptions are the same as those for 151,152,153, 254.

Purpose of Course:

To introduce students to one-variable calculus with an emphasis on understanding fundamental concepts and how to apply them in a variety of different contexts. Examples and problems are taken from many different fields and use numerical and graphical, as well as analytical methods.

Follow-up Course:

After finishing 151A students should be encouraged to take Math 152A and 153A. Students should be able to switch between the 151A, 152A, 153A sequence and the traditional calculus sequence.

Text:

Calculus, Single and Multivariable, Hughes-Hallett, Gleason, et al., 2nd ed.

Topics:

151A: Chapters 1, 2, 4, and 5. Topics include exponential, logarithmic, and trigonometric functions, and the concept, computations, and applications of derivatives.

152A: Chapters 3, 6, 7, and 8. Topics include antiderivatives, and the concept, computations, and applications of integration.

153A: Chapters 9, 11, 12, 16 and appendices A and B. Topics include approximations and series, functions of several variables, vectors, parameterized curves, polar coordinates, and complex numbers.

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For further information see:
Ruth Charney
2000-2001

Mathematics 151C
Mathematics 152C
Mathematics 153C
Mathematics 254C
All offered Au, Wi, Sp, Su

5 cr. each

Calculus and Analytic Geometry

Prerequisite:

The prerequisites are the same as those for 151, 152, 153, 254. e.g. for 151C the prerequisite is Math 150 or satisfactory score on the mathematics placement test.

Catalog Description:

The catalog descriptions are the same as those for 151,152,153,254.

Purpose of Course:

This sequence, Calculus & Mathematica, covers the material of Math 151,152,153, and 254 in a tutorial fashion, using an electronic "living" textbook on MacIntosh computers. The powerful graphing and symbolic manipulation available on microcomputers allows for upgrading the standard calculus courses to provide deeper insights than were previously possible. There are no lectures, only extensive tutorial sessions. Students work in the math lab for about two hours per day with supervision and help from faculty and graduate teaching assistants. There is also a weekly discussion session. Math 151C is open to Course Code L freshmen who have the attitude and interest to commit themselves to the course.

Follow-up Course:

After finishing 254C, students will be ready to move on to courses in differential equations or linear algebra. Additional Mathematica courses - 255C, 415C, and 513C - are now offered occasionally.

Text:

Calculus & Mathematica, Davis, Porta & Uhl, Addison-Wesley, 1994.

For 151C: Calculus & Mathematica: Derivatives
For 152C: Calculus & Mathematica: Integrals
For 153C: Calculus & Mathematica: Approximations
For 254C: Calculus & Mathematica: Vector Calculus

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For further information see:
Tony Nance
2000-2001

Mathematics 161 Au
Mathematics 162 Wi
Mathematics 263 Sp

5 cr. each

Accelerated Calculus with Analytic Geometry

Prerequisite:
Math 162--- 161 or written permission of department.
Math 263--- 162 or written permission of department.

Catalog Descriptions:

161: Derivatives and their applications, integrals and their applications, for real-valued functions of one variable.

162: Infinite sequences and series, polynomial approximation of functions and Taylor series expansion of functions; vector algebra and geometry with application to space curves and lines and planes in 3-space.

263: Partial derivatives and their applications, multiple integrals and their applications, for real-valued functions of several variables; line and surface integrals.

Purpose of Course:

The three course sequence, 161-162-263, is equivalent in content to the four course sequence 151-152-153-254. This accelerated sequence is designed for able students who are willing to learn some of the topics outside of class. As taught since Autumn 1990, 161 serves as a substitute for 151 and 152, 162 as a substitute for 153, and 263 substitutes for 254.

Follow-up Course:

Courses in differential equations or linear algebra, possibly H520.

Text:

Calculus with Analytic Geometry, 5th edition, R. Ellis and D. Gulick.

NOTE: The textbook for the Math 161 sequence and Math 151 sequence is the same. The text for the H161 sequence is different.

Topics:

161 - will assume mastery of the computational aspects of polynomial and trigonometric differentiation, and will concentrate on integral calculus of the polynomial, logarithmic, exponential, trigonometric and inverse trigonometric functions, integration techniques, and applications.

162 - Sequences and series, power series, Taylor's theorem, convergence tests, vectors, dot and cross product.

263 - Surfaces, cylindrical and spherical coordinates, partial derivatives, multiple integrals, line integrals, vector fields, Green's and Stoke's Theorems.

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Course Coordinator:
Henry Glover
2000-2001

Math 161G Au
Math 162 G Wi
Math 263G Sp

5 cr.

Accelerated Calculus with Analytic Geometry I, II, III

Prerequisite:

Students are individually chosen by the College of Engineering
Math 161G---Course code L placement and high school calculus.
Math 162G---161 or written permission of department.
Math 263G---162 or written permission of department.

Catalog Description:

161G:
Functions, limits and continuity, derivatives, applications of the derivative, the integral, inverse functions.

162G:
Techniques of integration; improper integrals; applications of the integral. Polynomial approximations and Taylor's Theorem; infinite sequences and series; tests for convergence; vectors, lines and planes.

263G:
Multivariable calculus (vector approach), line and surface integrals, vector differential operators.

Purpose:

These classes are part of the College of Engineering's Honors (FEH) Program, (previously known as the Gateway Program), in which selected students study core topics for the engineering curriculum in an integrated format. In 1993-94, the calculus was included with engineering mechanics in the classes ENG 194A, 194B, 194C. In 1994-95 they were offered as Math 194D, 194F, 194G. For 95-96 and 96-97 the third quarter was 294G. They were officially renamed 161G, 162G, 263G in 97-98.

Text:

Calculus with Analytic Geometry, (5^{th} ed.), R. Ellis and D. Gulick.

Topics:

Generally, the first quarter does the equivalent of 151 and 152. Generally, the second quarter covers153; and the third quarter covers 254, and some additional topics.

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Course Coordinator:
Nela Lakos
2000-2001

Mathematics H161 Au
Mathematics H162 Wi
Mathematics H263 Sp

5 cr.

Accelerated Calculus with Analytic Geometry

Prerequisite:

H161--Credit for Math 151, or satisfactory score on Department Qualifying Exam.
H162--H161 with a grade of C or better or written permission of Honors Committee chair.
H263--H162 with a grade of C or better or written permission of Honors Committee chair.

Catalog Description:

The catalog descriptions for H161, H162, and H163 are the same as those for 161,162, and 263 (respectively)-see listing for those courses.

HOWEVER-these descriptions as currently listed in the University Bulletin are not correct; for a more accurate description of their content, see "Topics" section below.

Purpose of Course:

This sequence is the honors version of the accelerated calculus sequence 161,162,263; it is *designed for students with credit for Math 151.* These courses are taught daily by faculty members in small classes with considerable student-teacher interaction. Students in this sequence will be held to higher standards of mathematical rigor than those in non-honors versions; they will be expected to demonstrate mastery of definitions and statements and proofs of theorems. Math H161 is a substitute for 151 and 152, H162 for 153, and H263 for 254.

Follow-up Course:

After completing H263, students will be ready for Math H520 (or any other course in differential equations or linear algebra).

Text:

Calculus with Analytic Geometry, Simmons

NOTE: The textbooks for the Math 161 sequence and Math 151 sequence are not the same.

Topics:

H161 will assume mastery of the computational aspects of polynomial and trigonometric differentiation, will briefly review the Mean Value Theorem, and will concentrate on integral calculus of the polynomial, logarithmic, exponential, trigonometric and inverse trigonometric functions, integration techniques, and applications.

H162-Sequences and series, power series, Taylor's theorem, convergence tests, vectors, dot and cross product, arc length, space curves.

H263-Vectors, parametric equations, surfaces, cylindrical and spherical coordinates, partial derivatives, multiple integrals, line integrals, vector fields, Green's theorem, Divergence theorem, Stokes' theorem.

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Course Coordinator:
V. Bergelson (Honors)
2000-2001

Mathematics	**H190 Au** **H191 Wi** **H264 Sp**	**5 cr.**	**Elementary Analysis I** **Elementary Analysis II** **Elementary Analysis III**

Prerequisite:

H190 - Permission of department
H191 - A grade of C or better in H190
H264 - A grade of C or better in H191

Catalog Descriptions:

H190: Special course for superior students.

H191: Continuation of H190.

H264: Continuation of H191; a rigorous treatment of multivariable integrals including gradients, multiple integrals, line and surface integrals, Green's theorem, the divergence theorem, and Stokes' theorem.

Purpose of Course:

This three-quarter sequence comprises the most intensive first year honors track in mathematics. It is designed to challenge talented, highly motivated students, regardless of their chosen major area of study. The courses introduce students to the mathematical underpinnings of calculus and stimulate the development of mathematical thinking, in addition to covering the material of the traditional calculus sequence. This sequence will substitute for Math 151, 152, 153, 254, and 551. H190 - H191 fulfill the analysis requirement for a Math major. The sequence is taught by faculty members in small sections with considerable teacher-student interaction.

Follow-up Sequence:

Math H520, H521, H522

Texts:

Calculus, Spivak, 3rd. ed -for H190, H191.
Vector Calculus, 3rd. ed., Marsden and Tromba -for H264

Topics:

H190 - H191: Properties of real numbers. Mathematical induction. Definition of integral. Integrals of polynomials and trigonometric functions. Applications. Continuity, limits, derivatives and applications. Fundamental Theorem of Calculus and integration techniques. Taylor series. Sequences and series of numbers and functions. Uniform convergence. Power series. If time permits, some differential equations or complex-valued functions.

H264: Multivariable calculus (vector approach), gradients, multiple integrals, line and surface integrals, Green's Theorem, divergence theorem, Stokes' Theorem.

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Course Coordinator:
V. Bergelson (Honors)
2000-2001

Mathematics 255 **5 cr.** **Differential Equations**
A, W, Sp, Su **and Their Applications**

Prerequisite:

Mathematics 254. Not open to students with credit for 256, 415, or 556.

Catalog Description:

Basic concepts and methods in solving ordinary differential equations, first and second order, linear differential equations, series solutions, numerical methods, Laplace transforms, physical applications.

Purpose of Course:

This course is an introduction to the most basic concepts and methods in solving ordinary differential equations. The emphasis of this course is on problem-solving. Upon completion of this course students should know some applications of ordinary differential equations in engineering, physics and some other branches of the sciences.

Text:

Elementary Differential Equations and Boundary Value Problems (6th edition), Boyce and DiPrima; Chapters 2, 3, 4, 5, 6.

Topics & Sample Syllabus

Sections	Topics	Approximate Time
2.1-2.5, 2.8-2.9	First Order Differential Equations	1-2 weeks
3.1-3.7	Second Order Linear Equations	1-2 weeks
4.1-4.3	Higher Order Linear Equations	1 week
5.1-5.8	Series Solutions of Second Order Linear Equations	2 weeks
6.1-6.5	The Laplace Transform	2 weeks

Review and additional topics can be added as time permits.

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Course Coordinator:
Yuval Flicker
2000-2001

Mathematics 345 **4 cr.** **Foundations of Higher Mathematics**
Au, Sp

Prerequisite:

Mathematics 254.

Catalog Description:

Designed to prepare students for higher mathematics: an introduction to logic, proof techniques, set theory, number theory, integers, real numbers, transfinite numbers.

Purpose of Course:

Math 345 is intended to teach students the language of mathematics, to teach them the role of definitions in mathematics, to teach them how to read and write simple proofs, and to provide them with a conceptual framework for the study of higher mathematics.

In calculus, students are expected mainly to learn and apply computational skills. In upper division math courses, especially in those which are aimed primarily at math majors, students need to be familiar with the concepts of proof and generalization. Math 345 is a transitional course intended to follow calculus (254 or 263) and precede introductory analysis (547) and algebra (580). Students may also find Math 345 helpful as preparation for probability (530), topology (560), linear algebra (568 or 571), number theory (573), geometry (574) and combinatorial mathematics and graph theory (575).

Text:

The Fundamentals of Higher Mathematics, Falkner

Other useful references:

Theory and Problems of Set Theory and Related Topics (Schaum's Outline), Lipschutz.
How to Read and Do Proofs, Solow.
The Foundations of Mathematics, Stewart and Tall.

Course Coordinator:
Neil Falkner
2000-2001

DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
231 WEST EIGHTEENTH AVENUE
COLUMBUS, OHIO 43210-1174

Mathematics 366 3 cr.
A, W, Sp, Su (1st Term)

Discrete Mathematical Structures I

Prerequisite:

Mathematics 132 or 152.

Catalog Description:

Mathematical formalization and reasoning, logic, Boolean algebra; sets, functions, relations, recursive definitions, mathematical induction; elementary counting techniques.

Purpose of Course:

To provide the foundation for a deeper understanding of the conceptual tools in computer science. Computers, however, are not used in this course. The desire of the CIS faculty is that the course presents math in rigorous form and requires students to deal with abstract systems and mathematical proofs.

Follow-up Course:

Math 566.

Text:

Discrete Mathematics with Applications, S. S. Epp, 2nd edition

(Over for Topics List)

Topics List & Sample Syllabus:

Sections	Topics
	THE LOGIC OF COMPOUND SETS
1.1	Logical Form and Logical consequence
1.2	Conditional Statements
1.3	Valid and Invalid Arguments
1.4	Application: Digital Logic Circuits
	THE LOGIC OF QUANTIFIED STATEMENTS
2.1	Predicates and Quantified Statements I
2.2	Predicates and Quantified Statements II
2.3	Arguments with Quantified Statements
	ELEMENTARY NUMBER THEORY AND METHODS OF PROOF
3.1	Direct Proof and Counterexample I: Introduction
3.2	Direct Proof and Counterexample II: Rational Numbers
3.3	Direct Proof and Counterexample III: Divisibility
3.4	Direct Proof and Counterexample IV: Division into Cases and the Quotient-Remainder Theorem
3.6	Indirect Argument: Contradicton and Contraposition
	SEQUENCES AND MATHEMATICAL INDUCTION
4.1	Sequences
4.2	Mathematical Induction I
4.3	Mathematical Induction II
4.4	Strong Mathematical Induction and the Well-Ordering Principle
	SET THEORY
5.1	Basic Definitions of Set Theory
5.2	Properties of Sets
5.3	The Empty Set, Partitions, Power Sets, and Boolean Algebras
	FUNCTIONS
7.1	Functions Defined on General Sets
7.3	One-to-One and Onto, Inverse Functions
7.5	Composition of Functions
	RELATIONS
10.1	Relations on Sets
10.2	Reflexivity, Symmetry, and Transitivity
10.3	Equivalence Relations
10.5	Partial Order Relations

Further topics if time permits:

	RECURSION
8.1	Recursively Defined Sequences
8.2	Solving Recurrence Relations by Iteration
8.4	General Recursive Definitions
	COUNTING
6.1	Counting and Probability
6.2	Possibility Trees and the Multiplication Rule
6.3	Counting Elements of Disjoint Sets: The Addition Rule
6.4	Counting Subsets of a Set: Combinations

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Course Coordinator:
Timothy Carlson
2000-2001

Mathematics 414 **3 cr.** **Group Studies:**
SP **Differential Equations for Engineering Applications**

(Prior to Spring 2001, this course was offered as 694D.)

Prerequisite:

To be taken concurrently with Aero-Eng 441 or permission from instructor.

Catalog Description:

Introduction to the basic methods for solving ordinary and partial differential equations, and some applications.

Purpose of Course:

This course is intended to introduce students to the basic methods for solving ordinary and partial differential equations, and to present some applications. This course will be coordinated with the course Aero-Eng 414, taught by the Dept. of Aerospace Engineering, Applied Mechanics, and Aviation, where students will be introduced to the physical concepts of conduction heat transfer and vibrations with applications primarily in aerospace engineering. Our goal is that the student will have a greater appreciation of the mathematical techniques being taught as well as developing skills to solve specific heat conduction and vibration problems that arise in engineering applications.

Texts:

Elementary Differential Equations and Boundary Value Problems, 6th edition, Boyce and DiPrima.

(Over for Topics List & Sample Syllabus)

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Topics List & Sample Syllabus:

Sections	Topics
1.1, 2.5, 2.7	Introduction to Differential Equations and some Applications: Cooling, Compound Interest, Mixing, and/or Mechanics.
2.1, 2.2	Linear First Order ODE's and Integrating Factors
2.5	Applications from Lecture 1 revisited
2.7, 2.3	Applications: Mechanics: Separable Equations
2.3, 2.4, 2.2	Differences Between Linear and Nonlinear Equations, Bernoulli's Equation
2.8	Exact equations
2.6	Qualitative Properties of solutions--Equilibrium solutions, Stability, sketch of solutions, apply to chemical kinetics
3.8, 3.1	Vibrations , Define Linear Homogeneous and Inhomogeneous Equations, Principle of Superposition of Solutions for Homogeneous Linear Equations, Constant Coefficient Equations with Distinct Roots of the Characteristic Polynomial
3.2, 3.3	Fundamental Solutions, Linear Independence, Wronskian
3.4, 3.5	Review Properties of Complex Numbers (Handout), Complex Roots, and Repeated Roots of the Characteristic Equation
5.5	Euler's Equation
3.6	Nonhomogeneous Equations: Method of Undetermined Coefficients
3.7	Nonhomogeneous Equations: Variation of Parameters
5.1	Review of Power Series
5.2	Examples of Series Solutions near an Ordinary Point
5.4, 5.6-5.8	Regular Singular Points, Frobenius Method, Bessel's Equation
10.2-10.4	Fourier Series, Convergence of Fourier Series, Even and Odd Functions
10.6	The Wave Equation--Derivation, Solution and Applications
6.1-6.3,6.6	Laplace Transform, Solution of Ordinary Differential Equations, Shifting Theorems, Convolution

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Course Coordinator:
George Majda
2000-2001

Mathematics 415 **4 cr.** **Ordinary and Partial**
A, W, Sp, Su **Differential Equations**

Prerequisite:

Mathematics 254

Catalog Description:

Ordinary, partial, linear and non-linear differential equations. Fourier series, boundary value problems and Bessel functions.

Purpose of Course:

To master the standard techniques of elementary ordinary differential equations, Fourier series, and separation of variables in partial differential equations. It is a combination of 255 (Differential Equations) and 512 (Fourier Series and Boundary Value Problems).

Text:

Elementary Differential Equations and Boundary Value Problems, 6th edition, Boyce and DiPrima.

Topics & Sample Syllabus

Section	Topics
2.1,2.2	Linear first order differential equations
2.3,2.4	Separable equations; differences between linear and non linear equations
2.5,2.6,2.7	Selected applications in population dynamics and mechanics
2.8	Exact Equations
3.1,3.2	Homogeneous equations with constant coefficients; fundamental solutions
3.3,3.4	Linear independence, the Wronskian; complex roots of characteristic equation
3.5	Repeated roots; reduction of order
3.6	Non homogeneous equations; method of undetermined coefficients
3.7	Variation of parameters
3.8,3.9	Mechanical and electrical vibrations; forced vibrations
5.1,5.2	Power series; series solutions near an ordinary point
10.1	Separation of variables; heat conduction
10.2,10.3	Fourier Series; Fourier Theorem
10.4,10.5	Even and odd functions; solution of other heat conduction problems
10.6	The wave equation: vibrations of an elastic string
10.7	Laplace's Equation

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Course Coordinator:
George Majda
2000-2001

Mathematics H487 **2 cr.** **Advanced Problem Solving**
Mathematics H187
Au

Prerequisite:

Permission of Department.

Catalog Description:

An advanced enrichment course for interested and capable students.

Purpose of Course:

To offer an experience in problem solving in mathematics for interested and talented students beyond what they would encounter in a standard program. This course is repeatable to a maximum of 6 credit hours, and is graded S/U. This course may not be counted in a major or minor program in Mathematics.

Topics:

Interesting special problems as chosen by the instructor.

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Course Coordinator:
V. Bergelson (Honors)
2000-2001

Mathematics 504 **5 cr.** **History of Mathematics**
Sp, Su

Prerequisite:

Mathematics 580 or 568 or 507, or permission of department.

Catalog Description:

Development of mathematics from primitive origins to present form; topics include: development of arithmetic, algebra, geometry, trigonometry, and calculus.

Purpose of Course:

This course is an introduction to the history of mathematics.
The course now has a two-fold purpose:

(i) Expose the students to the good mathematics of yesteryear (while placing the evolution of mathematics in a historical setting);
(ii) This course fulfills the spirit of the Third-Level Writing Course for math majors. Oral presentations, short essays, and a long final paper may be required.

Texts:

Texts used in the past include:

A History of Mathematics, Carl B. Boyer and Uta Merzbach
Mathematics and its History, Stillwell
A History of Mathematics - An Introduction, Victor J. Katz (2nd ed.)
Fermat's Enigma, S. Singh

Topics:

The topics will vary based on the instructors.

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Course Coordinator:
Bostwick Wyman
2000-2001

Mathematics 507 **5 cr.** **Advanced Geometry**
A, W

Prerequisite:

Mathematics 345 or GRAD standing

Catalog Description:

Advanced topics from Euclidean Geometry.

Purpose of Course:

To expand on the standard high school geometry curriculum, introducing related topics such as hyperbolic geometry to clarify and illustrate the special role played by Euclidean geometry.

Text:

Euclidean & Non-Euclidean Geometries, Greenberg, 3rd edition.

Topics:

I. Development of the axiom system underlying Euclidean geometry.

II. Investigation of the Euclidean and Hyperbolic parallel axioms.

III. Models of Hyperbolic Geometry

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Course Coordinator:
Joe Ferrar
2000-2001

Mathematics	**510.01** **510.02** **510.03**	**2-5 cr.**	**Topics in Mathematics for Elementary School Teachers**

Au, Wi, Sp, Su (listed this way in catalog - but see below)

Two sections of 510 were offered in Summer 1994. The last previous offering of any 510 was in Au 91.

Prerequisite:

One year teaching experience or permission of instructor.

Catalog Description:

Special topics in mathematics appropriate for teachers in the primary and intermediate grades. Repeatable to a maximum of 10 credit hours for each decimal subdivision with written permission of department.

Topics:

510.01: Geometry

510.02: Properties of Numbers

510.03: Numerical Methods

Audience

Designed for in-service teachers.

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Course Coordinator:
Not Currently Offered
2000-2001

Mathematics 512 **3 cr.** **Partial Differential Equations**
A, W, Sp, Su (1st Term) **and Boundary Value Problems**

Prerequisite:

Mathematics 255 or 415 or 556.

Catalog Description:

Fourier series, orthogonality relations, vibrating string, steady state heat, Laplace transform, and applications.

Purpose of Course:

This course develops problem solving skills with little emphasis on theory. Derivation of the partial differential equations from the physical models is not necessary. Students should be able to solve the PDE's and ODE's and interpret the solution.

Text:

Advanced Engineering Mathematics, 8th ed., Kreyszig

Topics List & Sample Syllabus

Sections	Topics	Approximate Time
10.1-10.5 10.6 & 10.7 Optional	Fourier Series	8 days*
11.1, 11.3-11.5	Partial Differential Equations**	8 days*
6.1-6.8	Laplace Transform	9 days*
If time permits: 11.13	Application of Laplace Transform to PDE's (or other applications).	3 days

*Including a test

**Only rectangular coordinates are considered. The text is a bit skimpy in the variety of examples and contexts in which separation of variables is used, especially with regard to Laplace's equation. It should be augmented somewhat.

Course Coordinator:
George Majda
2000-2001

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Mathematics 513 **3 cr.** **Vector Analysis for Engineers**
Au, Wi

Prerequisite:

Mathematics 254

Catalog Description:

Vector algebra, vector operators, line integrals, vector integral theorems, curvilinear coordinates; applications.

Purpose of Course:

A "skills" course designed to give familiarity with vector notation, vector operations, line and surface integrals and the main theorems of vector calculus.

Texts:

There are three possibilities:

Introduction to Vector Analysis, Davis and Snider, 7th edition
Advanced Engineering Mathematics, Kreyszig, 8th edition
Div, Grad, Curl and All That, Schey; and Schaum's outline Vector Analysis

Topics & Sample Syllabus

Sections	Topics	Approximate Time
1.1-1.12, 1.14	Review vector algebra, geometry, Dot and cross products, lines and planes	3 days
2.1-2.3 (2.4 optional)	Vector functions of one variable, arc length, Velocity, acceleration, curvature	5 days
3.1, 3.3-3.6	Vector and scalar functions, Chain Rule, Divergence, gradient and curl, directional derivative, normals, tangent planes	3 days
4.1-4.4, 4.8-4.12, 4.15, 4.16	Line integrals, potentials, surfaces, surface integrals, Green's Theorem, the Divergence Theorem, Stoke's Theorem, potentials, Applications	5 days

This syllabus is based on the Davis and Snider text. (Note: This book is too verbose, and some selectivity will be required. But it has many extra ideas and good descriptions of the meanings of the quantities studied.)

(Or different text:
Using Kreyszig, cover Chapters 8 and 9. This text is too terse and must be augmented slightly. (e.g. using Schaum's Outline))

Course Coordinator:
George Majda
2000-2001

Mathematics 514 **3 cr.** **Complex Variables for Engineers**
Sp

Prerequisite:

Mathematics 254

Catalog Description:

Introduction to complex variables, analytic functions, complex integral theorems, power series, residues, conformal mapping.

Purpose of Course:

This is a "skills" course. Subject matter is needed in Engineering courses. Some time on line integrals may be saved, and Green's Theorem may be used to get the Cauchy integral theorem, since these topics have been covered in Math 254.

Text:

Complex Variables and Applications, Churchill, 5th edition (used Sp 93, Sp 94, Sp 95), or
Advanced Engineering Math, Kreyszig, 8th edition

Kreyszig contains much diverse material. It is an excellent reference for engineers on many topics in mathematics.

Each text has too much material, so it is helpful to give a review sheet before tests. Use the text for reference and use the lectures to make the text understandable.

Sample Syllabus #1 Based on Churchill:

Topics	**Approximate Time** (days)
Complex numbers, polar form	3
Analyticity, Cauchy-Riemann equations	3
Elementary functions	4
TEST	
Mapping by elementary functions	3
Cauchy integral theorem and consequences	5
TEST	
Power series	3
Residues, definite integrals	6

Sample Syllabus #2 Based on Kreyszig: *(2 tests and a final exam)*

Topics	**Approximate Time** (days)
Complex analytic functions	9
Complex integrals	5
Power Series, Taylor and Laurent Series	4
Integration by residues	6
Conformal Mapping (omit 16.5)	4
Complex functions and potential theory: (if time permits and prior material is grasped)	

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Course Coordinator:
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2000-2001

Mathematics H520 Au — **5 cr. each** — **Linear Algebra**
H521 Wi — **Differential Equations**
H522 Sp — **Complex Analysis**

Prerequisites:

H520-H263 or H264 with a grade of C or better, or written permission of Honors Committee chairperson. Not open to students with credit for H290.

H521-H520 with a grade of C or better or written permission of Honors Committee chairperson. Not open to students with credit for H291

H522-H521 with a grade of C or better or written permission of Honors Committee chairperson. Not open to students with credit for H292

Catalog Descriptions:

H520: Vector spaces, linear transformations, systems of equations, determinants, eigenvalues, spectral theorem, Cayley-Hamilton theorem.

H521: Ordinary, linear and nonlinear differential equations, existence and uniqueness theorems, Fourier series, boundary value problems, systems, Laplace transforms, phase space, stability and periodic orbits.

H522: Analytic functions, Cauchy integral theory, residue calculus, series representations, conformal mapping. The sequence H520-H521-H522 substitutes for 568 and 569; 255 or 415; 416 or 514 or 552

Purpose of Course:

This three quarter sequence is the second year of the honors program in mathematics. It is designed to challenge talented, highly motivated students, regardless of their chosen major. This sequence substitutes for Math 568 and 569, Math 255 or 415, and Math 514 or 552; the level of rigor is higher than in any of these classes. It is taught by faculty members in small sections with considerable teacher-student interaction.

Texts vary, for example:

Strang, Linear Algebra and Its Applications
Friedberg, Linear Algebra, 2nd Edition (used in H520, Au 93, Au 94 and Au 95)
Simmons, Differential Equations with Applications and Historical Notes (used in H521, Wi 94)
Marsden and Hoffman, Basic Complex Analysis, 2nd Edition
Boas, Invitation to Complex Analysis (used in H522, Sp 94)

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Course Coordinator:
V. Bergelson (Honors)
2000-2001

Mathematics 530 **3 cr.** **Probability I**
Au

Prerequisite:

Mathematics 254. Not open to students with credit for Statistics 520.

Catalog Description:

Combinatorial probability, random variables, independence, expectations, variance, limit theorems.

Purpose of Course:

To introduce students to the fundamentals of probability theory and to teach them how to apply these fundamentals to solve problems.

Follow-up Course

Math 531 if it is offered.

Text:

Probability, Jim Pitman.

Topics:

Sets
Probability
Counting
Random Variables
Independence and conditioning
Mean, variance
Limit theorems

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Course Coordinator:
Neil Falkner
2000-2001

Mathematics 532 **3 cr.** **Mathematical Foundations**
Sp **of Actuarial Science**

Prerequisite:

Mathematics 530 or Statistics 520, or permission of instructor.

Catalog Description:

Problem Workshop for applications of calculus and probability to risk management.

Purpose of Course:

To introduce students to the syllabus for the Society of Actuaries/Casualty Actuarial Society Examination 1. The course will contain a quick review of ideas from calculus and probability, an introduction to the ideas of risk management needed for the examination, and extensive problem solving. Most students will sit for Exam 1 in May.

Text:

Actex One-Pack, review manual for Exam 1.

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Course Coordinator:
Bostwick Wyman
2000-2001

Mathematics H540 **5 cr.** **Geometry and Calculus in Euclidean Spaces and on Manifolds I**
Wi*

*** Offered in odd years only (Wi 1999, Wi 2001, WI 2003)**

Prerequisite

Mathematics H520, or H263 and 569, or permission of the instructor

Catalog Description

Introduction to convex sets in E^n, some point set topology in E^n, (including compactness and connectedness properties of subsets of E^n), differentiation of vector valued functions of several variables, relative extrema, the inverse and implicit function theorems, and an introduction to Lebesgue integration in E^n.

Purpose of Course

The sequence H540, H541 is meant to provide an introduction the geometry and/or topology of n-dimensional Euclidean space and manifolds in a context that makes it relevant to the students' other studies. The sequence is meant to be conducted in a mathematically rigorous manner and will therefore provide more exposure for the students to precise mathematical definitions and proofs.

Follow-up course

Math H541.

Text

Elements of Differential Geometry, R. Millman and G. Parker, (or similar level text)

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For Further Information See:
V. Bergelson (Honors)
2000-2001

Mathematics H541 **5 cr.** **Geometry and Calculus in Euclidean Spaces and on Manifolds II**
Sp*

*** Offered in odd years only (Sp 1999, Sp 2001, Sp 2003)**

Prerequisite

Mathematics 540, or permission of the instructor

Catalog Description

Review and completion of the discussion of Lebesgue integration in E^n, coverage of change of variables theorems in E^n, differentiation of parametrized integrals, curves in E^n, differential 1-forms, line integrals, the exterior algebra and differential calculus in E^n, differential forms and tensor algebra, integration on manifolds, the divergence theorem, and Stokes' theorem.

Purpose of Course

The sequence H540, H541 is meant to provide an introduction the geometry and/or topology of n-dimensional Euclidean space and manifolds in a context that makes it relevant to the students' other studies. The sequence is meant to be conducted in a mathematically rigorous manner and will therefore provide more exposure for the students to precise mathematical definitions and proofs.

Text

Elements of Differential Geometry, R. Millman and G. Parker
(or similar level text)

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For Further Information See:
V. Bergelson (Honors)
2000-2001

Mathematics 547 **3 cr.** **Introductory Analysis I**
A, W

Prerequisite:

Mathematics 345.

Catalog Description:

547, 548, 549 is an integrated sequence in advanced calculus covering sequences, limits, continuous functions, differentiation, Riemann integral; infinite series, sequences and series of functions, Taylor series, improper integrals.

Purpose of Course:

547, 548, 549 is a sequence designed to develop analytic intuition and proof skills. Student participation is emphasized. One of the primary purposes of 547 is that the student gain experience with concrete estimates.

Follow-up Course:

Math 548.

Text:

Introduction to Analysis, Arthur Mattuck

Topics:

1. Monotone functions. Monotone sequences.
2. Boundedness. Estimations.
3. Definition of the limit of a sequence. Limit rules. Standard examples.
4. Principle of nested intervals. The Bolzano-Weierstrass Theorem. The Cauchy Criterion. Supremum and infimum.
5. Infinite series. Comparison tests. Ratio and root tests. Integral test. Absolute convergence.

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Course Coordinator:
Bogdan Baishanski
2000-2001

Mathematics 548 **3 cr.** **Introductory Analysis II**
Wi, Sp

Prerequisite:

Mathematics 547

Catalog Description:

Continuation of 547

Purpose of Course:

547, 548, 549 is a sequence designed to develop analytic intuition and proof skills. Student participation is emphasized.

Follow-up Course:

Math 549 or 551 or 552.

Text:

Introduction to Analysis, Arthur Mattuck

Topics:

1. Conditionally convergent series. Alternating series. Rearrangements.
2. Power series.
3. Continuous functions.
4. Limits of functions.
5. Uniform continuity.
6. Definition of the derivative. Differentiation rules.
7. Mean-Value Theorem.
8. L'Hospital's Rules.
9. Convexity.

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Course Coordinator:
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2000-2001

Mathematics 549 **3 cr.** **Introductory Analysis III**
Au,Sp

Prerequisite:

Mathematics 548.

Catalog Description:

Continuation of 548; the Riemann-Stieltjes integral; an introduction to the calculus of several variables.

Purpose of Course:

547, 548, 549 is a sequence designed to develop analytic intuition and proof skills. Student participation is emphasized. 549 is a continuation of 548.

Text:

Introduction to Analysis, Arthur Mattuck

Topics:

1. Taylor's Theorem.
2. Definition of the Riemann integral. A piecewise continuous function is Riemann integrable. Properties of the integral.
3. Fundamental Theorem of Calculus. Integraton by parts and change of variable.
4. Exponential and logarithmic function.
5. Improper integrals.
6. Functional sequences and series.
7. Uniform convergence.
8. Power series and analytic functions.

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Course Coordinator:
Bogdan Baishanski
2000-2001

Mathematics 551 **5 cr.** **Vector Analysis**
Au, Sp

Prerequisite:

Mathematics 254

Catalog Description:

Vector operations in three dimensions, vector operators, surface area, the theorems of Green and Stokes, the Divergence Theorem; applications.

Purpose of Course:

The course is designed to enable students to understand and use the techniques of vector analysis in 2 and 3-dimensional spaces. Applications to the geometry of curves and surfaces will be emphasized. This course is not open to students with credit for 416 or 513.

Text:

Vector Calculus, Thomas H. Barr

Other References:
Advanced Calculus, 2nd ed., Wilfred Kaplan. (With supporting problems from Schaum's.)
Vector Calculus, 3rd Edition, T.E. Marsden and A. J. Tromba. (used 90-91)

Topics:

Review of vectors (dot product, cross product), curves, gradient, curl, divergence, line integrals, surface integrals, the Divergence Theorem, Green's Theorem, Stoke's Theorem and applications of these theorems.

Any selection of topics made by the instructor should aim to leave enough time in the end to cover the divergence theorem and Stoke's theorem.

Sections	Topics	Approximate Time
1.1-1.7 (1.2-1.3 optional)	Review of vectors (dot product and cross product), lines and planes	2 weeks
1.8-1.9	Vector valued functions, derivatives	
3.7	Gradient	2 weeks
3.8	Divergence and curl	
4.1, 4.2, 4.5, 4.6	Arc length, line integrals, surface area, integrals	6 weeks
5.1-5.4	Conservative vector fields, Green's Theorem, Divergence Theorem, Stoke's Theorem	

Section 4.6 introduces notation of differential forms but it doesn't really go into the topic of differential forms. Other possible topics that could be included are the topics of Curvilinear coordinates: curl and divergence in spherical and cylindrical coordinates (for example, from the book Vector Analysis, Davis/Snyder, Section 3.10).

Course Coordinator:
Luis Casian
2000-2001

Mathematics 552 **5 cr.** **Introduction to the Theory of Functions of a Complex Variable**
Su

Prerequisite:

Mathematics 254

Catalog Description:

Topics discussed include power series expansions, the formula of Cauchy, residues, conformal mappings, and elementary functions in the complex domain.

Purpose of Course:

The students are to learn the basic facts and techniques of complex variables, as done in, for instance, the first eight or more chapters of Churchill and Brown. The fact that it is a 5 hour course permits more depth than is possible in 514 or 416. Because the course has minimal prerequisites, the emphasis will be on problem solving techniques. This course is not open to students with credit for 416 or 514.

Text:

Fundamentals of Complex Analysis, Saff & Snider, 2nd edition

or
Complex Variables and Applications, Churchill and Brown, or
Advanced Engineering Mathematics, Kreyszig, or
any one of a dozen others

Topics:

Algebra of complex numbers, geometry of the complex plane, elementary functions, conformal mappings, Taylor's and Laurent's series, residue calculus.

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Course Coordinator:
Luis Casian
2000-2001

Mathematics 556 **3 cr.** **Differential Equations I**
W

Prerequisite:

Mathematics 255, and prerequisite or concurrent 572.

Catalog Description:

Systems of linear, first-order differential equations, existence and uniqueness theorems, numerical methods, qualitative theory (phase plane analysis, linearization, stability, limit cycles),physical applications.

Purpose of Course:

To provide the student with the modern mathematical foundations of differential equations. Course Objectives: systems of linear, first-order differential equations, existence and uniqueness theorems, qualitative theory (phase plane analysis, linearization, stability, limit cycles).

Text:

Ordinary Differential Equations and Stability Theory: An Introduction, Sanchez

Topics & Sample Syllabus

Topics	Approximate Time
Linear Systems of Differential Equations	4 weeks
Existence and Uniqueness	1 week
Qualitative Analysis of Nonlinear Equations in the Plane	5 weeks

Grading:

Two midterms (100 pts. each), homework (100 points) and final exam (200 pts.).

Note:

This course will not be offered in 2000-2001.

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Course Coordinator:
David Terman
2000-2001

Mathematics 557 **3 cr.** **Differential Equations II**
Sp

Prerequisite:

Mathematics 556

Catalog Description:

Sturm - Liouville theory, partial differential equations in three or more variables, nonhomogeneous problems, Green's functions, and physical applications.

Purpose of Course:

An introduction to the basic properties of PDE's and to the techniques for analyzing them. Course Objectives: Basic properties of PDE's, wave equation, diffusion equation, Laplace's equation, Fourier series, and boundary value problems.

Possible Text:

Partial Differential Equations: An Introduction, W.A. Strauss, was used 1994.

Topics and Sample Syllabus

Sections	Topics	Approximate Time
1.1-1.4	Where PDE's Come From	2 weeks
2.1-2.5	Waves & Diffusion	2 weeks
4.1-4.3	Boundary Value Problems	2 weeks
5.1-5.4	Fourier Series	2 weeks
6.1-6.3	Harmonic Functions	2 weeks

Possible grading:

Two midterms (100 pts. each), homework (100 points), and final exam (200 pts.)

Note:

This course will not be offered in 2000-2001.

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Course Coordinator:
David Terman
2000-2001

Mathematics 568 **3 cr.** **Introductory Linear Algebra I**
A, W, Sp, Su (1st Term)

Prerequisite:

Mathematics 254. Not open to students with credit for 471, 571 or 577.

Catalog Description:

The space R^n and its subspaces; matrices as mappings; matrix algebra; systems of equations; determinants; dot product in R^n ; geometric interpretations.

Purpose of Course:

The purpose of the course is to provide an introduction to the concepts, vocabulary and results of linear algebra with geometric interpretations in the space R^n. Emphasis is on techniques, computational skills, and fundamental concepts.

Follow-up Course:

None.

Text:

Linear Algebra and its Applications, Lay, Addison-Wesley, 2nd ed.

Topics and Sample Syllabus

Sections	Topics
	LINEAR EQUATIONS IN LINEAR ALGEBRA
1.1	Systems
1.2	Row Reduction
1.3	Vector Equations
1.4	The Matrix Equation
1.5	Solution Sets of Linear Systems
1.6	Linear Independence
	ORTHOGONALITY AND LEAST-SQUARES
6.1	Inner Product, Length, Orthogonality
6.2	Orthogonal Sets
6.3	Orthogonal Projections
6.4	The Gram-Schmidt Process
	LINEAR EQUATIONS IN LINEAR ALGEBRA
1.7	Introduction to Linear Transformations
1.8	The Matrix of a Linear Transformation
	MATRIX ALGEBRA
2.1	Matrix Operations
2.2	Inverses
2.3	Invertible Matrices
	EIGENVALUES AND EIGENVECTORS
5.1	Eigenvalues
5.2	Characteristic Equation
5.3	Diagonalization
5.4	Linear Transformations

Sections	Topics
	VECTOR SPACES
4.1	Subspaces
4.2	Null Spaces and Column Spaces
4.3	Independence and Basis
4.4	Dimension
4.5	Rank
4.6	Change of Basis
	DETERMINANTS
3.1-3.2	Properties of Determinants
3.3	Cramer's Rule

Course Coordinator:
Bostwick Wyman
2000-2001

Mathematics 569 **3 cr.** **Introductory Linear Algebra II**
A, W, Sp, Su (2nd Term)

Prerequisites:

Mathematics 568. Not open to students with credit for 572.

Catalog Description:

Vector spaces over R and C; linear transformations; the polynomial ring R[x]; characteristic values and vectors; inner product spaces; quadratic form reduction; principal axis theorem.

This course was last offered Wi 98 and is not projected to run for this year.

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For further information see:
E. Overman
2000-2001

Mathematics 571 **3 cr.** **Linear Algebra for**
A, Sp, Su (1st Term) **Applications I**

Prerequisite:

Math 254. Not open to students with credit for 569 or 601.

Catalog Description:

Linear systems of equations; vector spaces, matrices, linear operators; inner products, projections and least squares, approximations of eigenvalue problems. Applications.

Text:

Linear Algebra Labs with Matlab, Hill & Zitarelli, 2nd edition
Linear Algebra with Applications, S. Leon, 5th edition

Topics List:

The course combines theoretical linear algebra (Leon) with hands-on experience (Hill & Zitarelli, and the software package Matlab). All classes are held in a MacIntosh Lab. Chapters 1-3 and the first half of chapter 5 will be covered from Leon. No programming is required for this course.

Leon:

Sections	Topics
Chapter 1	Matrices and Systems of Equations
Chapter 2	Determinants
Chapter 3	Vector Spaces
Chapter 5 (5.1-5.4)	Orthogonality

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Course Coordinator:
Ed Overman
2000-2001

Mathematics 572 **3 cr.** **Linear Algebra for**
Wi, Su (2nd Term) **Applications II**

Prerequisite:

Math 571 or written permission of the department.

Catalog Description:

The eigenvalue problem for inner product spaces, projections and least squares approximation; classification of operators and quadratic forms; applications.

Text:

Linear Algebra Labs with Matlab, Hill & Zitarelli, 2nd edition
Linear Algebra with Applications, S. Leon, 5th edition

Topics List:

This is a continuation of 571. Chapter 5 of Leon's book will be completed, and Chapters 4 and 6 covered. There will be additional selected applications.

Leon:

Sections	Topics
Chapter 5	Orthonormal Sets (Sections 5.5-end of chapter)
Chapter 4	Linear Transformations
Chapter 6	Eigenvalues

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Course Coordinator:
Ed Overman
2000-2001

Mathematics 573 **5 cr.** **Elementary Number Theory**
Sp of odd numbered years

Prerequisite:

Mathematics 153

Catalog Description:

Utilization of concrete examples to introduce concepts of modern algebra; prime numbers, congruences, Diophantine equations, elementary combinatorial analysis.

Purpose of Course:

To introduce students to concepts in elementary number theory which serve as important examples of more general notions in modern abstract algebra; to develop reasonable facility in proofs involving these concepts.

Text:

An Introduction to the Theory of Numbers, 3rd edition, Niven and Zuckerman (or equivalent)

Topics:

1. Divisibility properties of integers; primes, Euclidean algorithm, unique factorization, greatest common divisors, least common multiples.

2. Linear Diophantine equations.

3. Congruences; Euler's function, Euler-Fermat Theorem, primitive roots.

4. Linear congruences, Chinese Remainder Theorem, quadratic congruences, Quadratic Reciprocity Law.

5. Optional Topics: Pythagorean Triples, sums of squares, cryptography, higher degree Diophantine equations.

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Course Coordinator:
Paul Ponomarev
2000-2001

Mathematics 574 **5 cr.** **Geometry**
Sp of even-numbered years

Note: This course was not offered in Sp 2000 and will not be offered in Sp 2001.

Prerequisite:

Mathematics 568.

Catalog Description:

Euclidean and non-Euclidean geometry, emphasizing algebraic connection; Affine and projective planes, duality. Topics from: geometry of groups; finite planes, Hilbert's postulates, n-dimensional spaces.

(NOTE: The "Topics from" part of the catalog description is misleading. See below for the emphasis of the course.)

Purpose of Course:

To strengthen geometric intuition, stress geometric aspects of linear algebra, and to introduce the student to geometries different from high school geometry. Kaplansky's little book, Linear Algebra and Geometry: A Second Course, conveys the ideal spirit one should try to achieve.

Topics:

Construction of the real projective plane from the affine plane, barycentric and homogeneous coordinates, duality, affine and projective transformations, double ratio. Conic sections, and the group of a conic section. Exercises on projective planes over Z mod p.

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For More Information See:
Joseph Ferrar
2000-2001

Mathematics 560 **4 cr.** **Point-Set Topology**
Sp

Prerequisite:

Mathematics 345.

Catalog Description:

Sets and functions, metric spaces, topological spaces, subspaces, limits, closure, interior, sequences, convergence, separation axioms, continuity, connectedness, compactness, product spaces, Euclidean spaces.

Purpose of Course:

Math 560 offers an introduction to topological concepts. Students are asked for elementary proofs, although prior experience with proofs is not expected.

Follow-up Course:

Before taking further Topology courses, a student will need Math 547-548. Math 560 has significant overlap with Math 640. Math 655, 656, 657 is the follow-up sequence for students who have had or take concurrently Math 651, 652, 653.

Text:

Topological Spaces, Buskes and Van Rooij (Springer)
(or an equivalent text approved by the Course Coordinator)

Topics & Sample Syllabus

Topics	Approximate Time
Preliminaries	1 1/3 weeks
Metric spaces	2/3 week
Open and closed sets	2/3 week
Convergence and continuity	2/3 week
Product spaces	1/3 week
Special properties including completeness, separable, second countable	2 weeks
Compactness	1 1/3 weeks
Connectedness	1 week
Homeomorphisms and topological properties	1 week
Quotient spaces (optional)	

Grading:

There should be two midterms (worth 100 points each) and one final examination (worth 200 points). Homework is a very important part of this course and therefore should be worth 150 points.

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Course Coordinator:
Yung-Chen Lu
2000-2001

Mathematics 566 **3 cr.** **Discrete Mathematical Structures II**
A, W, Sp, Su (2nd Term)

Prerequisite:

Mathematics 366.

Catalog Description:

Algorithms, efficiency of algorithms; pigeonhole principle, combinatorial identities, inclusion-exclusion, generating functions; graphs, Euler tours, Hamiltonian cycles, isomorphism, planarity, colorings, algorithms on weighted graphs, networks.

Purpose of Course:

Follow-up to Math 366. The desire of the CIS faculty is that this course present math in rigorous form and require students to deal with abstract systems and mathematical proofs.

Text:

Discrete Mathematics and its Applications, Rosen, 3rd edition.

Topics and Sample Syllabus

Sections	Topics
	LOGIC, SETS, AND FUNCTIONS
1.8	The Growth of Functions
	ALGORITHMS, THE INTEGERS AND MATRICES
2.1	Algorithms
2.2	Complexity of algorithms
2.3	The Integers and Division
2.4	Integers and Algorithms
2.5	Applications of Number Theory
	MATHEMATICAL REASONING
3.4	Recursive Algorithms
	ADVANCED COUNTING TECHNIQUES
5.1	Recurrence Relations
5.2	Solving Recurrence Relations
5.4	Inclusion-Exclusion
5.5	Applications of Inclusion-Exclusion
A.3	Generating Functions
	GRAPHS
7.1	Introduction to Graphs
7.2	Graph Terminology
7.3	Representing Graphs & Graph Isomorphism
7.4	Connectivity
7.5	Euler and Hamiltonian Paths
7.6	Shortest Path Problems
7.7	Planar Graphs
7.8	Graph Coloring
	TREES
8.1	Introduction to Trees
8.5	Spanning Trees
8.6	Minimal Spanning Trees

Course Coordinator
Timothy Carlson
2000-2001

Mathematics 575 **5 cr.** **Combinatorial Mathematics**
Wi, Sp **and Graph Theory**

Prerequisite:

Mathematics 568.

Catalog Description:

Matching theory, graph theory, network flows, and optimization; enumeration techniques; combinatorial designs and coding theory.

Purpose of Course:

The purpose of this course is to acquaint the student with some aspects and applications of modern combinatorial theory; in particular, to communicate the meaning of the word "combinatorial" and to develop the student's facility for dealing with discrete and essentially non-algebraic mathematical problems. The primary emphasis is on theory, but numerous illustrations and applications are presented. In addition, much of the theory has developed in response to practical optimization problems of various kinds.

The course is designed to serve both the prospective mathematics graduate student as well as the student with an interest in or need for combinatorial techniques and tools.

Text:

Combinatorics, Russell Merris

Topics List:

Fundamental counting principles, combinatorial identities, binomial and multinomial coefficients, partitions of integers and sets, Stirling numbers, principle of inclusion-exculsion, the pigeonhole principle, graphs, edge- and vertex- colorings, chromatic polynomials, matchings, latin squares, orthonality of latin squares, finite projective planes, block designs, symmetric block designs, Hadamard matrices.

(Over for Syllabus)

Topics List & Sample Syllabus:

Sections	Topics
Chapter 1	THE MATHEMATICS OF CHOICE
1.1	Fundamental Counting Principles
1.2	Pascal's Triangle
1.5	Combinatorial Identities
1.6	Four ways to Choose
1.7	Binomial & Multinomial Theorems
1.8	Partitions
1.9	Newton's Identities
Chapter 2	THE COMBINATORICS OF FINITE FUNCTIONS
2.1	Stirling Numbers---Second Kind
2.2	Bells, Ball, and Urns
2.3	Principle of Inclusion-Exclusion
2.4	Disjoint Cycles
2.5	Stirling Numbers---First Kind
Chapter 5	ENUMERATION IN GRAPHS
5.1	The Pigeonhole Principle
5.2	Edge Colorings and Ramsey Theory
5.3	Chromatic Polynomials
5.4	Planar Graphs
5.5	Matching Polynomials
5.6	Graphic Sequences
Chapter 6	DESIGNS AND CODES
6.1	Latin Squares
6.2	Balanced Incomplete Block Designs
As time permits:	
Chapter 4	GENERATING FUNCTIONS
4.1	Difference Sequences
4.2	Ordinary Generating Functions
4.3	Applications of Generating Functions
4.4	Exponential Generating Functions
4.5	Recurrence Techniques

Course Coordinator:
Thomas Dowling
2000-2001

Mathematics **H576 Wi*** **5 cr. each** **Number Theory**
H577 Sp* **Through History I, II**

***Offered only in the Winter quarter of even years**
***Offered only in the Spring quarter of even years**

Prerequisite:

H576: H190, H191, and H520, or permission of the department.
H577: H576 or permission of the department.

Catalog Description:

H576:
The integrated honors sequence H576-H577 includes elementary analytic and algebraic number theory and traces its unifying role in development of mathematics through history.

H577:
Continuation of H576.

Purpose of Course:

The intention of this sequence is to present number theory, the "Queen of Mathematics" through its historical development. Being one of the oldest mathematical disciplines, number theory, in the course of its history, both benefited from and contributed to such major mathematical areas as geometry, algebra and analysis. These courses will be especially beneficial for honor students planning to pursue careers in mathematics, physics, computer science and education, but may be of interest to engineering students as well.

Texts:

An Introduction to the Theory of Numbers, G. Hardy and E. Wright
A Course in Number Theory, H. Rose

(over for Suggested Topics List)

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Suggested Topics List

H576:

1. Review of Egyptian and Mesopotamian Mathematics. Greek tradition. Three classical Greek problems (cube doubling, angle trisection, circle quadrature).

2. Famous irrationalities.

3. Continued fractions and applications thereof (quadratic surds, Pell's equation, diophantine approximations, etc.)

4. More on diophantine approximation. Algebraic numbers. Liouville numbers. A glimpse into the Thue-Siegel-Roth Theorem.

5. Uniform distribution modulo one. Weyl criterion. Some important sequences. Pisot-Vijayaraghavan numbers. Formulation and discussion of Margulis' solution of Oppenheimer's conjecture.

6. Normal numbers. Champerwoun's example. Almost every number is normal. Levy-Khinchine
Theorem on normality of continued fractions.

H577:

1. Infinitude of primes. Euler's identity. Chebyshev's Theorem. Bertraud's Postulate. Dirichlet's Theorem on primes in progressions. Average rate of growth of classical number-theoretical functions.

2. Finite fields. Wedderburn's Theorem. Applications: Latin Squares and Cryptography.

3. Quadratic reciprocity.

4. Pythagorean triangles. Representation of integers as sums of squares. Quaternions, Caley's octavas. Hurwitz' Theorem. Minkowsky's geometry of numbers.

5. p – adic numbers, their construction and axiomatic characterization (Ostrowski's Theorem). Minkowski-Hasse principle.

6. Fermat's last theorem. Some easy cases. A glimpse into modern developments (elliptic curves, Mordell-Weil Theorem, etc.).

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Course Coordinator:
Vitaly Bergelson
2000-2001

Mathematics 578 **5 cr.** **Discrete Mathematical Models**
Au, Sp

Prerequisite:

CIS 221, and Mathematics 568, and either Mathematics 530 or Statistics 425.

Catalog Description:

Analysis and solution of various applied problems using discrete mathematical models; methods used include theory of eigenvectors and eigenvalues from linear algebra, graph theory, linear optimization, Markov chains and queues.

Purpose of Course:

1. To introduce the mathematical structures and develop the mathematics appropriate for discrete modeling.
2. To demonstrate and encourage use of computers in solving mathematical problems
3. To give students an experience with a real world application for which they can construct a model that can be used to explore possible solutions.
4. To apply mathematical concepts and techniques encountered in earlier courses in the context of discrete modeling in a way that brings a new vividness and interest to the ideas.

Text:

Discrete Dynamical Systems, Sandefur

Other References:

Discrete Mathematics, Norman L. Biggs; Mathematical Modeling, Maki & Thompson; Applying Mathematics, Burghes, Huntly & McDonald; Computer Simulation, Nancy Roberts et al, Addison-Wesley; Applications of Linear Algebra, Anton and Rorres, Wiley; An Introduction to Mathematical Models, Olinick; A variety of different modules available through COMAP

Topics:

This course can examine a number of different topics in which the tools of discrete mathematics are used in the development of mathematical models. Among the topics could be:

1. Discrete deterministic models developed from numerical data.
2. Markov processes
3. Random processes and Monte Carlo simulation.
4. Linear optimization and the simplex algorithm.
5. Graph theory, including shortest paths, minimum weight spanning trees, and job scheduling.
6. Network flows and the Ford-Fulkerson algorithm for maximum flow.
7. Additional modeling topics as time and the interests of the instructor permit.

As a pedagogical tool, assignment of a term project involving discrete modeling with class reports the last week of the quarter, is highly recommended.

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Course Coordinator:
D. Ray-Chaudhuri
2000-2001

Mathematics	**580**	**Au, Wi**	**3 cr. each**	**Algebra I**
	581	**Wi, Sp**		**Algebra II**
	582	**Sp, Au**		**Algebra III**

Prerequisite:

Mathematics 568 (may be taken concurrently with 580) and Mathematics 345.

Catalog Description:

The integrated algebra sequence 580, 581, 582 includes elementary number theory, group theory, vector spaces and linear transformations, field theory.

Purpose of Course:

The 580-581-582 sequence covers topics in the theory of polynomial equations, number theory, geometry, linear algebra, and algebraic structures in a unified and integrated way.

The principal goal of the sequence is to show how abstract algebraic structures and methods deepen and enrich our understanding of the basic structures and concepts of school mathematics-numbers and arithmetic, polynomial equations, congruence and symmetry, ruler and compass constructions.

Text:

Notes by R. Solomon

Topics:

580: Theory of equations, elementary number theory, elementary properties of groups, Lagrange's Theorem.

581: More elementary number theory, theory of equations, ring theory, group theory, ruler and compass constructions.

582: Three-dimensional groups of motions. Some linear algebra. Elements of Galois Theory.

Course Coordinator:
Ron Solomon
2000-2001

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Mathematics 588 **4 cr.** **Practicum in Actuarial Science**
Sp

Prerequisite:

3rd year standing and completion of second writing course. Open only to actuarial science majors.

Catalog Description:

Presentations by practicing actuaries on topics drawn from their fields of expertise; oral presentations by students on selected topics in actuarial science.

Purpose of Course:

To introduce students to actuarial practice and hone their communication skills. We expect that this course will serve as the third writing course for the actuarial science major.

Text:

There is no text for this course.

Topics:

Various topics in life, health, and property and casualty insurance, pension and benefits consulting, chosen by the visitors.

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Course Coordinator:
Bostwick Wyman
2000-2001

Mathematics	**H590 Au**	**5 cr.**	**Algebraic Structures I**
	H591 Wi	**5 cr.**	**Algebraic Structures II**
	H592 Sp	**5 cr.**	**Algebraic Structures III**

Prerequisite:

H590---H520 with a grade of C or better, or written permission of Honors Committee Chairman.
H591---H590 with a grade of C or better or written permission of Honors Committee Chairman.
H592---H591 with a grade of C or better or written permission of Honors Committee Chairman.

Catalog Description:

Integers, congruence relations, structure preserving maps, topics from groups, rings, modules, vector spaces, fields. The sequence H590, H591, H592 substitutes for the sequence 580,581,582.

Text:

Algebra, M. Artin
Abstract Algebra, D. Dummit and R. Foote
Topics in Algebra, I. Herstein

Suggested Topics :

H590:

1. Integers, unique factorization; congruences, Euler function.
2. Groups, subgroups, homomorphisms and isomorphisms, normal subgroups, quotient groups, permutation groups, cyclic groups, Cauchy Theorems, Sylow's Theorems; direct products, fundamental theorem for finite Abelian group; G-sets.
3. Rings, subrings, ideals, morphisms, polynomial rings, prime and maximal ideals.

H591:

1. Commutative rings, factorization theory, Euclidean rings, principal ideal rings, unique factorization domains, Gauss' lemma; illustrations in the integers of quadratic number fields.
2. Modules over commutative rings, submodules, quotients and direct sums; fundamental theorem for modules over principal ideal domains.
3. Vector spaces (as a special case of modules); linear maps and matrices, canonical forms, dual spaces.
4. The theory of determinants.

H592:

1. Bilinear and quadratic forms; inner product and unitary spaces; principal axis theorem.
2. Fields, algebraic and transcendental (extensions), existence of closure (over countable fields), tests for polynomial irreducibility; normality, separability, field automorphisms.
3. Galois theory, the subgroup-subfield correspondence theorem, group theory interrelations; extensions of finite fields, cyclotomic extensions.
4. Solvable groups and solvability by radicals.

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For Further Information See:
V. Bergelson (Honors)
2000-2001

Mathematics 601 **3 cr.** **Mathematical Principles**
Au **in Science I**

Prerequisites:

Several quarters of mathematics at the 400-500 level, including Mathematics 568.

Catalog Description:

Linear algebra in finite dimensions, abstract vector spaces, linear transformations, fundamental subspaces, complex inner product spaces.

Purpose:

To make available an updated advanced-undergraduate/graduate course sequence which accommodates the academic (mathematical) and scheduling needs of client departments as well as those of the mathematics department.

Text:

Introduction to Linear Algebra, Johnson, Riess & Arnold, (chapter 4)
Linear Algebra and its Applications, Strang, (chapter 5)

(Over for Topics List)

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Topics List

I. VECTOR SPACES (approximately 10 days*)
- Axiomatic properties
- Subspaces
- Spanning sets
- Linear independence
- Bases and coordinates
- Dimension
- Linear functionals and covectors
- Dual of a vector space
- Bilinear functionals
- Metric
- Isomorphism between vector space and its dual

II. LINEAR TRANSFORMATIONS (approximately 10 days)
- Null space, range space
- Dimension Theorem, Implicit Function Theorem for a linear system
- Classification of linear transformations
- Invertible transformations
- Existence and uniqueness of a system of equations
- Algebraic operations with linear transformations
- The Representation Theorem
- Change of basis, change of representation, and the transition matrix
- Invariant subspaces, commuting operators and eigenvectors

III. INNER PRODUCT SPACES (approximately 5 days)
- Inner products
- Orthogonormal bases
- Gram-Schmidt orthogonalization process
- Orthogonal matrices
- Right and left inverses
- Least squares approximation, Bessel's inequality, normal equations
- The four fundamental subspaces of a matrix
- The Fredholm alternative, uniqueness=existence
- Intersection and sum of two vector space

IV. EIGENVALUES AND EIGENVECTORS (approximately 5 days)
- Eigenvector basis
- Diagonalizing a matrix
- Generalized eigenvectors
- Phase portrait of a system of linear differential equations
- Powers of a matrix
- Markov processes
- Adjoint of an operator

(1 day = one 48 min. lecture)*

Grading Criteria:

Weekly homework and one final exam.

Follow-up Course:

Math 602

Course Coordinator:
Ulrich Gerlach
2000-2001

Mathematics 602 **3 cr.** **Mathematical Principles**
Wi **in Science II**

Prerequisite:

Mathematics 601

Catalog Description:

Eigenvalue and eigenvector analysis in finite dimensions, quadratic forms, singular value decomposition, linear analysis in infinite dimensions, Sturm-Liouville Theory, Hilbert spaces.

Purpose of Course:

To make available an updated advanced-undergraduate/graduate course sequence which accommodates the academic (mathematical) and scheduling needs of client departments as well as those of the mathematics department.

Text:

I. Eigenvalues and eigenvectors:

Linear Algebra and its Applications, Strang, (Ch. 5, 6, and Appendix A)

II. & III. Infinite-dimensional vector spaces:

1. Linear Mathematics in Infinite Dimensions, U. Gerlach, (Ch. 1 and 3)
2. a) Fourier Series and Boundary Value Problems, Churchill and Brown, (Ch. 3)
   b) Mathematical Methods in Physics and Engineering, Dettman, (Ch. 2)

(over for Topics List)

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Topics List

I. EIGENVALUES AND EIGENVECTORS
(approximately 20 days)*

- Hermetian operators
- Spectral Theorem
- Triangularization via unitary similarity transformation
- Diagonalization of normal matrices
- Positive definite matrices
- Quadratic forms and the generalized eigenvalue problem
- Extremization with linear constraints
- Rayleigh quotient
- Singular value decomposition of a rectangular matrix
- Pseudo-inverse of a rectangular matrix

II. INFINITE DIMENSIONAL VECTOR SPACES: EXAMPLES
(II & III approximately 10 days)

- Sturm-Liouville systems: regular, periodic, and singular
- Sturm-Liouville series

III. INFINITE DIMENSIONAL VECTOR SPACES: PRINCIPLES

- Inner product spaces
- Complete metric spaces
- Hilbert spaces
  - Square summable series and square integrable functions
- Least squares approximation
  - Projection theorem
  - Generalized Fourier coefficients
- Bessel's inequality, Parceval's equality and completeness
- Unitary transformation between Hilbert spaces

*(*1 day = one 48 min. lecture)*

Grading Criteria:

Weekly homework and one final exam.

Follow-up Course:

Math 603

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Course Coordinator:
Ulrich Gerlach
2000-2001

Mathematics 603.02 **3 cr.** **Mathematical Principles**
Sp **in Science III**

Prerequisite:

Some complex analysis. Mathematics 514 would be sufficient.

Catalog Description:

An introduction to partial differential equations (pdes) that arise in the mathematical and engineering sciences.

Purpose of Course:

To make available an updated advanced-undergraduate/graduate course sequence which accommodates the academic (mathematical) and scheduling needs of client departments as well as those of the mathematics department.

Text:

Linear Mathematics in Infinite Dimensions, Gerlach (Ch. 2, 4, 5)

I. Fourier Theory:
   Fourier Series and Boundary Value Problems, Churchill and Brown, (Ch. 4, 5, 7)
II. Green's Function Theory:
   Principles of Applied Mathematics, Friedman, (Ch. 3-5)
III. Theory of solutions to pdes in 2 and 3 dimensions:
   Partial Differential Equations in Physics, Sommerfeld, (Ch. IV, II)
   Mathematical Methods of Physics, Mathews and Walker, (Ch. 8)

(over for Topics List)

Topics List

I. FOURIER THEORY
(I & II approximately 20 days)*
- Fourier series
- Dirichelet kernel
- Fourier's Theorem on a finite domain
- Sequences leading to the Dirac delta function
- Fourier transform representation
- Change of basis in Hilbert space:
  - Orthonormal wavelet and wavepacket representations

II. GREEN'S FUNCTION THEORY: INHOMOGENEOUS DIFFERENTIAL EQUATIONS
- Homogeneous systems
- Adjoint systems
- Inhomogeneous systems
- The concept of a Green's function
- Solution via Green's function
- Integral equation of a linear system via its Green's function
- Classification of integral equations
- The Fredholm alternative
- Green's function and the resolvent of the operator of a system
- Eigenfunctions and eigenvalues via residue calculus
- Branches, branch cuts, and Riemann sheets
- Singularity structure of the resolvent of a system:
  - Poles and branch cuts
  - Effect of boundary conditions and domain size

III. THEORY OF SOLUTIONS TO PARTIAL DIFFERENTIAL EQUATIONS IN TWO AND THREE DIMENSIONS
(approximately 10 days)
- Partial differential equations: hyperbolic, parabolic, and elliptic
- The Helmholtz equation and its solutions in the Euclidean plane
  - Geometry of the space of solutions
  - Plane waves vs. cylinder waves:
  - Why, and when to use them
  - Sommerfeld's integral representation
  - Hankel, Bessel, and Neumann waves
  - Change of basis in the space of solutions: partial waves
  - Displaced cylinder waves
  - The Cylindrical Addition Theorem
  - Method of steepest descent and stationary phase
- Analytic behavior of cylinder waves
- Interior (cavity) and exterior (scattering) boundary value problems
- Cauchy problem and characteristics
- Spherical waves: symmetric and nonsymmetric

*(*1 day = one 48 min. lecture)*

Grading Criteria:

Weekly homework and one final exam.

Possible Follow-up Course

Math 701

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Course Coordinator:
Ulrich Gerlach
2000-2001

Mathematics 618 **3 cr.** **Theory of Interest**
Wi (Two 1 1/4-hour classes)

Prerequisite:

Mathematics 254, or permission of instructor.

Catalog Description:

Mathematical techniques of use in analyzing financial transactions involving interest: measurement of interest, force of interest, annuities-certain, applications to actuarial sciences.

Purpose of Course:

Undecided students looking to actuarial science as a possible course of study or profession may find this course to be a valuable indicator of their aptitude and interest. This course includes the material on the mathematics of compound interest in Examination 2 of the Society of Actuaries and the Casualty Actuarial Society. The course is required for the undergraduate major in actuarial science.

Text:

The Theory of Interest, 2nd edition, S. G. Kellison.

Topics:

The minimum course content is:

1. Measurement of interest and discount, compound interest.
2. Force of interest, equations of value.
3. Annuities-certain, continuous annuities, varying annuities.
4. Amortization, numerical calculation of yield rates.
5. Valuation of securities.
6. Measurement of interest on a fund, life insurance settlement options, installment loans.
7. Depreciation, depletion, capitalized cost.

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For further information see:
Bostwick Wyman
2000-2001

Mathematics	**630 Au**	**3 cr.**	**Actuarial Mathematics I**
	631 Wi		**Actuarial Mathematics II**
	632 Sp		**Actuarial Mathematics III**

Prerequisite:

Mathematics 618, and Mathematics 530 or Statistics 520 or equivalent; or permission of instructor.

Catalog Description:

630: Individual risk models; survival distributions and life tables; life insurance annuities

631: Continuation of 630; net premiums and net premium reserves; multiple life functions; multiple decrement models.

632: The Mathematics 632 syllabus will be revised to match the topics in Examinations 3 and 4.

Purpose of Courses:

This sequence is designed to introduce students to the mathematical content of the theory of contingencies. The sequence includes some material from the new Examinations 3 and 4 of the Society of Actuaries and the Casualty Actuarial Society. The sequence is required for the undergraduate major in actuarial science.

Text:

Actuarial Mathematics., 2nd edition, Newton L. Bowers, Jr., et al, Society of Actuaries, 1997.

For further information see:
Bostwick Wyman
2000-2001

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Mathematics 650 **5 cr.** **Principles of Mathematical Analysis**
Su

Prerequisite:

Mathematics 547 or permission of the Graduate Advising Committee.

Catalog Description:

Riemann-Stieltjes Integral; Uniform Convergence and Interchange of Limit Processes, Special Functions, Fourier Series.

Purpose of Course:

New graduate students in Statistics and Mathematics will form the core of the audience. This group will be supplemented by students from various disciplines. These students need more maturity in mathematical analysis for their graduate work. This course will help them to become aware of main pitfalls in analysis, to realize the need for a rigorous argument, to gain facility in using Mathematica software for graphical and numerical exploration, and--through a detailed study of well-chosen examples—to develop analytic intuition.

Text:

A Radical Approach to Real Analysis, by David Bressoud

Topics:

Fourier Series
Different Forms of Remainder in Taylor's Formula
Taylor Series (binomial series, $\sin x$, $\cos x$, $\exp x$, $\log(1+x)$, $x/(e^x-1)$, etc.)
The Newton-Raphson Method
Differentiability and Continuity
Hypergeometric Series and Gauss' Convergence Test
Summation by Parts and its Applications
Groupings and Rearrangements. Term by Term Differentiation and Integration.
Bonnet Mean-Value Theorem and Dirichlet-Theorem on Convergence of Fourier Series
Wallis Formula. Bernoulli Numbers and Bernoulli Polynomials. Stirling's Formula.

Course Coordinator:
B. Baishanski
2000-2001

Mathematics	**651 Au**	**5 cr. each**	**Introduction to Real Analysis I**
	652 Wi		**Introduction to Real Analysis II**
	653 Sp		**Introduction to Real Analysis III**

Prerequisite:

Permission of Department.

Catalog Description:

651: Real numbers, infinite sequences and series.

652: Continuous functions, differentiable functions and functions of bounded variation; Riemann-Stieltjes integral.

653: Measurable sets and functions, elementary theory of the Lebesgue integral.

Purpose of Course:

Basic analysis course for mathematics M.S. students, Mathematics Ph.D. students with incomplete prerequisites, and a few others. General work on writing proofs, and on analytic intuition. These courses are the preparation for the Qualifying Exam in Analysis.

Follow-up Courses:

Math 722: Theory of Probability I
Math 750: Real Analysis I
Math 767: Introduction to the Theory of Approximation I

Possible Texts:

Introduction to Real Functions and Orthogonal Expansions, B. Sz.-Nagy, (used 98-99 and 99-00)
651: Chapter 1, add. mat.; 652: Chapters 2,3,4; 653: Chapters 5,6 and parts of 7 & 8
[Out of print, but arrangements have been made for the text for the course.]

or:
The Way of Analysis, R. Strichartz, (used 1995-96); supplementary material may be required

or:
An Introduction to Classical Real Analysis, K. Stromberg, (used 94-95 and 96-97);
651: Chapters 2 and 3; 652: Chapters 4, 5 and 7 (except optional sections); 653: Chapter 6

or:
A First Course in Real Analysis, S. Berberian
651: Chapters 1-4, 10; 652: Chapters 5-9; 653: Chapter 11 and supplementary material

or: equivalent text chosen by the instructor--If another text is chosen, be sure to cover the Qualifying Exam syllabus.

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For Further Information see:
Paul Nevai
2000-2001

Mathematics	**655 Au**	**4 cr. Each**	**Elementary Topology I**
	656 Wi		**Elementary Topology II**
	657 Sp		**Elementary Topology III**

Prerequisite:

Permission of Department. Reasonable undergraduate background in calculus in Euclidean spaces - for example H540/H541 and/or an undergraduate course in topology or differential geometry, eg. 560. Some background in linear algebra (eg. 568) is desirable. For 656 and 657 an introductory course in undergraduate algebra along the lines of 580 is required (may be taken concurrently).

Catalog Descriptions:

655:
Continuity, compactness, connectedness in metric and general topological spaces, completeness in metric spaces.

656:
Continuation of 655; products, quotients, separation axioms, convergence, metrization and compactifications for general topological spaces.

657:
Continuation of 656; fundamental group and covering spaces.

(NOTE: The catalog description is obsolete. See below.)

Purpose of Course:

The 655-656-657 sequence is an introduction to topology for beginning graduate students and advanced undergraduates. 655 is a quick introduction to basic concepts of point set topology: compactness, connectedness, quotient spaces, manifolds (particularly surfaces). 656 is devoted to the fundamental group and covering spaces, while 657 is an introduction to homology theory.

Follow-up Courses:

Math 860-861-862 for algebraic topology; Math 866-867-868 for differential topology

Possible Texts:

Basic Topology, by M. A. Armstrong, Springer-Verlag, 1994.
A Basic Course in Algebraic Topology, by W. S. Massey, Springer-Verlag, 1991.
Elements of Algebraic Topology, by J. R. Munkres, Addison-Wesley, 1993.
Algebraic Topology: A First Course, by M. J. Greenberg & J. R. Harper, Addison-Wesley, 1982.

Depending on the background of the students and how much point set topology you want to cover, you might supplement Armstrong with:

Topology, 2nd ed., by J. R. Munkres, Prentice-Hall, 1999.

(over for Topics List)

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Topics List:

Metric and topological spaces and continuity
Connectedness and path-connectedness
Compactness
Quotient spaces
Topological manifolds
Classification of closed surfaces
The fundamental group
Seifert-Van Kampen theorem
Covering spaces
Simplicial complexes
Homology groups
Mayer-Vietoris sequence and excision
Brouwer fixed point theorem, degree of a map
Jordan-Brouwer separation theorem
Euler characteristic

Possible Additional Topics:

Metrization theorems
Space-filling curves
Branched covers
Knots and knot groups
Fundamental theorem of algebra & extensions to quaternions & octonions
Borsuk-Ulam theorem
Lefschetz fixed point theorem

See also: http://www.math.ohio-state.edu/~fiedorow/math655

Course Coordinator:
Zbigniew Fiedorowicz
2000-2001

Mathematics	**670 Au**	**5 cr.**	**Algebra I**
	671 Wi		**Algebra II**
	672 Sp		**Algebra III**

Prerequisite:

Permission of Department. Reasonable undergraduate algebra background - for example, 568, 580, 581, 582. At least one year (including linear algebra) strongly recommended.

Catalog Descriptions :

670:
Elementary theory of groups, permutation groups, Polya theory of counting, rings and ideals, polynomials.

671:
Continuation of 670: vector spaces, linear transformations, canonical forms for matrices, linear programming, orthogonality.

672:
Continuation of 671: quadratic forms, finite fields, various applications.

(NOTE: These descriptions are not always accurate in reflecting the current content of the courses. The content does vary year-to-year depending on the instructor and text. See other side for one sample syllabus.)

Purpose of Course:

Standard entry course for M.S. students in mathematics. Should supply much of the material needed for the Qualifying Examination in Algebra.

Text:

Abstract Algebra, Dummit & Foote (used starting in 670, Au 95)
or
Algebra, Artin (used 1992-93, 1993-94, and 1994-95)
or
Topics in Algebra, Herstein.

(Over for Topics List and Sample Syllabus)

Topics List & Sample Syllabus:

Topics	Approximate Time
670:	
ELEMENTARY NUMBER THEORY Gcd, Congruence, Euler-Fermat Theorem	3 weeks
BASIC LINEAR ALGEBRA Vector Spaces (especially finite-dimensional and function spaces), Bases, Change of Basis; Linear Operators and their Matrices, Rank and Nullity, Determinants, Eigenvalues and Eigenvectors, Minimal and Characteristic Polynomials and the Cayley-Hamilton Theorem; Simultaneous Diagonalization	5 weeks
BASIC GROUP THEORY Elementary Concepts: Element Order, Cyclic Groups, Lagrange's Theorem	2 weeks
671:	
Statement and Proof of Structure Theorem on Finitely Generated Abelian Groups.	3 weeks
Group Theory with Emphasis on Groups Acting on Sets, Sylow Theorems	2 weeks
Statement and Proof of Rational and Jordan Canonical Form.	3 weeks
BASIC BILINEAR ALGEBRA Bilinear and Hermitian Forms, Inner Product Spaces, Gram-Schmidt, Orthogonal Decompositions and Projections	2 weeks
672:	
BASIS COMMUTATIVE RING THEORY Rings (with 1), Homomorphisms, Ideals, Principal Ideals, Prime and Maximal Ideals, Quotient Rings. PID's, UFD's. Ideals and Quotients of k[x].	4 weeks
GALOIS THEORY Finite Extensions of Q, Basic Galois Correspondence. Finite Fields. Solvability by Radicals. Straight-edge and Compass Constructions.	6 weeks

(This sample syllabus was based on the Artin text, as used in1993-94. The content and the sequence will vary depending on the text and instructor.)

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