Department of Mathematics
The Ohio State University

2005-2006 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
151A	Calculus and Analytic Geometry
152A	Calculus and Analytic Geometry
153A	Calculus and Analytic Geometry
254A	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
161A	Accelerated Calculus with Analytic Geometry I
162A	Accelerated Calculus with Analytic Geometry II

Course Number	Course Title
263A	Accelerated Calculus with Analytic Geometry III
161H	Accelerated Calculus with Analytic Geometry
162H	Accelerated Calculus with Analytic Geometry
263H	Accelerated Calculus with Analytic Geometry
187H	Advanced Problem Solving
487H	Advanced Problem Solving
190H	Elementary Analysis I
191H	Elementary Analysis II
264H	Elementary Analysis III
254	Calculus and Analytic Geometry IV
255	Differential Equations and Their Applications
255C	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
415C	Ordinary and Partial Differential Equations
504	History of Mathematics
507	Advanced Geometry
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
566	Discrete Mathematical Structures II
568	Introductory Linear Algebra I
571	Linear Algebra for Applications I
572	Linear Algebra for Applications II
573	Elementary Number Theory
575	Combinatorial Mathematics & Graph Theory

Course Number	Course Title
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
665	Modern Mathematical Methods in Relativity Theory I
666	Modern Mathematical Methods in Relativity Theory I
670	Algebra I
671	Algebra II
672	Algebra III
701	Mathematical Principles in Science III: Calculus of Variations & Tensor Calculus

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.

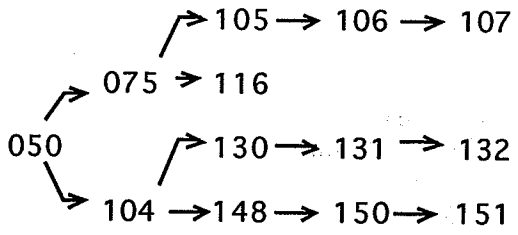
Purpose of Course:

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, 4th ed.

(Over for Topics List and Sample Syllabus)

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THE OHIO STATE UNIVERSITY
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Topics List & Sample Syllabus

Sections	Topics
1.1-1.8	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
2.1-2.6	EQUATIONS, INEQUALITIES, AND PROBLEM SOLVING
	Simplifying Algebraic Expressions
	The Addition and Multiplication Property of Equality
	Solving Linear Equations
	An Introduction to Problem Solving
	Solving Linear Inequalities
	Review and 1st Midterm
	Formulas, Percent and Problem Solving
	Further Problem Solving
1.9, 3.1-3.6	GRAPHING
	Reading Graphs
	The Rectangular Coordinate System
	Graphing Linear equations
	Intercepts; Slope; Graphing Linear Inequalities
	Point-slope formula
5.1-5.6	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
6.1-6.6	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
2005-2006

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

Prerequisite:

Mathematics 050, or Course Code S 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.

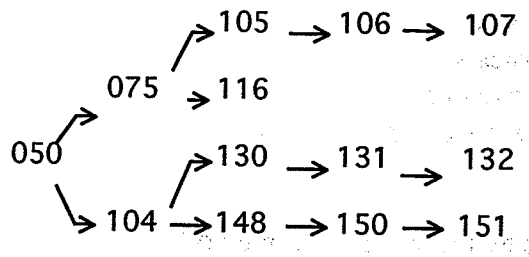
Follow-up Courses:

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

Math 105 for students intending to pursue Med in early or middle childhood.

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

Sequencing Chart:



Text:
Beginning Algebra, (4th ed.) Martin-Gay

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(Over for Topics List & Sample Syllabus)

Topics List & Sample Syllabus

Sections	Topics
6.1-6.5	FACTORING POLYNOMIALS
	Greatest common factor and factoring by grouping
	Factoring trinomials
	Factoring binomials
	Solving quadratic equations by factoring
7.1-7.5	RATIONAL EXPRESSIONS
	Simplifying rational expressions
	Multiplying and dividing rational expressions
	Adding and subtracting rational expressions
	Least common denominator
	Solving equations containing rational expressions
	Review and first midterm
7.6	RATIONAL EXPRESSIONS
	Proportion and problem solving with rational expressions
3.4-3.6	GRAPHING
	Slope and rate of change
	Slope-intercept form
	Point-slope form
4.1-4.4	SOLVING SYSTEMS OF LINEAR EQUATIONS
	Solving systems of linear equations by graphing
	Solving systems of linear equations by substitution
	Solving systems of linear equations by addition
	Systems of linear equations and problem solving
	Review and second midterm
8.1-8.7	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
9.1-9.3	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
	Review and final exam

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Course Coordinator:
Brian McEnnis
2005-2006

Mathematics 076 **4 cr.** **Reentry Precollege Math**
Wi

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.

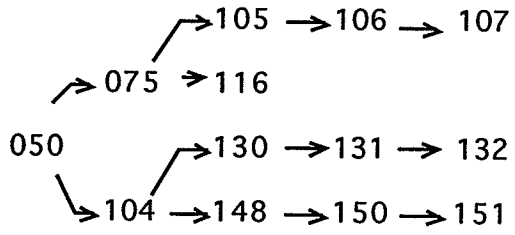
Purpose of Course:

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
2004-2005

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

Catalog Description:

Supplement to Math 104 using small-group student-centered active learning to create a new paradigm for learning mathematics

Prerequisite:

New first quarter freshman, no math admission condition (i.e. 3 or more units of college prep math), optional for Math Placement T (may take 050 or 103/104) and Math Placement S (may take 050, 075, or 103/104); Concurrent enrollment in Math 104 required.

Purpose of Course:

This course offers an opportunity for at-risk NFQF [Math Course Code T and S] to develop the skills needed to learn Math. Enrollment in 103 enables code T students to concurrently enroll in Math 104, in place of registration in Math 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 used parallel the content of Math 104 while enhancing students' ability to "process" and "strategize" the mathematics.

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Course Coordinator:
Harry Allen
2005-2006

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.

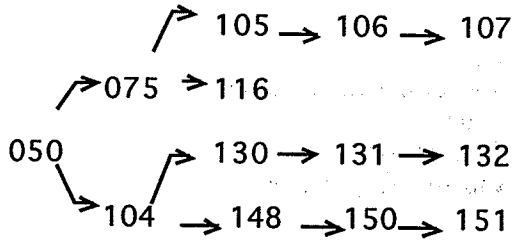
Purpose of Course:

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:

Intermediate Algebra for The Ohio State University; Hall/Mercer. ISBN 0-073-10932-0. This is a custom version of the standard Hall and Mercer Beginning and Intermediate Algebra text.

(Over for Topics List and Sample Syllabus)

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Topics List & Sample Syllabus

Section	Topics
3.3	Solving Systems of Equations Graphically and Numerically
3.4/3.5	Solving Systems Using the Substitution and Addition Methods
3.6	Applications of Systems
4.1/4.2	Linear Inequalities
4.3	Compound Inequalities
4.4	Absolute Value Equations and Inequalities
6.1	Functions and Representation of Functions
6.2	Linear and Absolute Value Functions
6.3	Quadratic, Square Root, Cubic, and Cube Root Functions
	Review and Exam 1
6.4	Horizontal and Vertical Translations
6.7	Linear Factors of Polynomials and Zeros
7.1/7.2	Factoring
7.3/7.4	Special Forms and General Factoring Strategy
7.5	Solving Equations by Factoring
8.1	Radicals
8.2	Addition and Simplification of Radicals
8.3	Multiplication and Division of Radicals
	Review and Exam 2
8.4	Complex Numbers
8.5	Quadratic Equations and Inequalities
8.6	Equations with Radicals
8.7	Applications of Quadratic Equations
9.1	Rational Functions and reducing Rational Expressions
9.2/9.3	Operations on Rational Expressions
9.4	Simplifying Complex Rational Expressions
9.5	Solving Equations Containing Rational Expressions
	Review and Exam 3
9.6	Applications Yielding Equations with Fractions

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Course Coordinator:
Carmen Lefever
2005-2006

Mathematics 105 **5 cr.** **Fundamental Mathematics Concepts for Teachers I**
Au, Wi

**Currently being taught in either lecture/recitation or workshop format.*

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, integers, rational numbers, and combinatorial counting techniques.

Follow-up Course:

Math 106

Text:

Mathematics for Elementary Teachers, Beckmann, Pearson/Addison-Wesley

Topics List for Math 105

I. Problem solving
II. Numbers and the decimal system
III. Fractions
IV. Addition and subtraction
V. Multiplication
VI. Multiplication of fractions, decimals, and negative numbers
VII. Division Course Coordinator:

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H. Clemens
2005-2006

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

**Currently being taught in either lecture/recitation or workshop format.*

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 106 introduces length, area, volume, angle, Euclidean geometry, congruent and similar triangles, symmetry and rigid motion, and knowledge of general spatial skills.

Follow-up Course:

Math 107

Text:

Mathematics for Elementary Teachers, Beckmann, Pearson/Addison-Wesley

Topics List for Math 106

I. Geometry
II. Geometry of motion and change
III. Measurement
IV. Area and volume
    A. Broader Context: Role of Geometric Intuition in Mathematical Concept Formation

Course Coordinator:
H. Clemens
2005-2006

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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.

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 107 deals with combinatorics, probability, functions, sequences and series, logic, compound interest, and general mathematical skills.

Text:
Mathematics for Elementary Teachers, Beckmann, Pearson/Addison-Wesley

Topics List

I. Number theory
II. Functions and algebra
III. Statistics
IV. Probability

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Course Coordinator:
H. Clemens
2005-2006

Mathematics 116 **5 cr.** **Excursions in Mathematics**
***Au, Wi, 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:

Excursions in Modern Mathematics, 5th ed, Tannenbaum

Topics List:

Euler circuits
Graphs, Euler's theorem, Fleury's algorithm for an Euler circuit, Eulerizing graphs

Traveling Salesman Problem
Hamilton circuits and paths, complete graphs, simple strategies for TSP, algorithms for approximate TSP solutions

Networks
Trees, minimum spanning trees, Kruskal's algorithm for finding minimum spanning trees

Voting
Preference ballots, five different methods of determining the winner of an election with 3 or more candidates

Apportionment
Some U.S. history on congressional districts, basic concepts, Hamilton's method, quota rule, Alabama paradox, other methods

Spiral growth in nature
Fibonacci numbers, golden ratio , the equation $x^2 = x+1$, gnomons, gnomonic growth

Population growth
Population growth dynamics, exponential growth models, logistic growth models

Counting
Counting principles, permutations and combinations

Symmetry
Geometric symmetry, rigid motions, reflections, rotations, translations, glide reflections, patterns

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Course Coordinator:
Tom Dowling
2005-2006

Mathematics 117 **5 cr.** **Survey of Calculus**
Au, Wi, Sp

Prerequisite:

Mathematics 148, 150, Course Code L, or Permission from the Math Department

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 Early Childhood and Middle Childhood Ed. students doing a Math Concentration. The intent of the course is to provide students with basic concepts and skills associated with calculus, along with the applications of the topic.

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:

Single Variable Calculus: Concepts and Contexts, by James Stewart (Edition 3E, 2005). Published by Thomson Brooks/Cole. ISBN: 0-534-41022-7.

Calculator:

A graphing calculator is required for this course. Most instructors will be familiar with the Texas Instrument TI-83. NOTE: The TI-89, TI-92, and any calculator that uses a Computer Algebra System are not allowed in this course.

(Over For Topics List And Sample Syllabus)

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Topics List & Sample Syllabus

Sections **Topics**

Chapter 2: Limits and Derivatives
- 2.1: The Tangent and Velocity Problems
- 2.2: The Limit of a Function
- 2.3: Calculating Limits using the Limit Laws
- 2.6: Tangents, Velocities, and Other Rates of Change
- 2.7: Derivatives
- 2.8: The Derivative as a Function
- 2.9: What does f' say about f?

Chapter 3: Differentiation Rules
- 3.1: Derivatives of Polynomial and Exponential Functions
- 3.2: The Product and Quotient Rules
- 3.3: Rates of Change in the Natural and Social Sciences
- 3.4: Derivatives of Trigonometric Functions
- 3.5: The Chain Rule
- 3.6: Derivatives of Inverse Trigonometric Functions
- 3.7: Derivatives of Logarithmic Functions
- 3.8: Linear Approximation and Differentials

Chapter 4: Applications of Differentiation
- 4.2: Maximum and Minimum Values
- 4.3: Derivatives and the Shapes of Curves
- 4.4: Graphing with Calculus and Calculators
- 4.6: Optimization Problems
- 4.9: Antiderivatives

Chapter 5: Integrals
- 5.1: Areas and Distances
- 5.2: The Definite Integral
- 5.3: Evaluating Definite Integrals
- 5.4: The Fundamental Theorem of Calculus
- 5.5: Integration by Substitution
- 5.8: Integration using Tables
- 5.9: Approximate Integration

Chapter 6: Applications of Integration
- 6.1: More about Areas
- 6.2: Volumes
- 6.3: Arc Length
- 6.4: Average Value of a Function
- 6.5: Applications in Physics and Engineering (e.g., Moments and Center of Mass, Hydrostatic Force)
- If Time: Surface Area

Brief Overview of Multivariable Calculus (If time permits)
- Partial Derivatives, Tangent/Normal Planes, Optimization
- Multiple Integrals, Volume, Center of Mass

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Course Coordinator:
Victor Ferdinand
2005-2006

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:

Math 130 is a pre-calculus course with a finance section slanted toward a business program. The applications are business related.

Follow-up Course:

Math 131

Text:

Mathematics of Finance, taken from Introductory Mathematical Analysis for Business, Economics & the Life & Social Sciences, 11th ed., by Haeussler, Paul & Wood

Topics & Sample Syllabus

Sections	Topics
0.7/0.8/1.1	Applications of Equations, Linear Equations
1.2/1.3	Applications of Inequalities
2.1/2.2/2.5	Special Functions, Graphs in Rectangular Coordinates
3.1/3.2	Lines, Applications, and Linear Functions
3.3/3.4	Quadratic Functions, System of Linear Equations
3.5/3.6	Nonlinear Systems, Applications of Systems of Equations
4.1	Exponential Functions
4.2/4.3	Logarithmic Functions, Properties of Logarithms
4.4	Logarithmic and Exponential Equations
5.1/5.2	Compound Interest, Present Value
5.3	Annuities
5.4	Loans and Amortization

THE OHIO STATE UNIVERSITY
DEPT. OF MATHEMATICS
231 W. 18th AVE.
COLUMBUS, OHIO 43210

Course Coordinator
Bostwick Wyman
2005-2006

Math 131 **4 cr.** **Mathematical Analysis for Business II**
Au, Wi, Sp, Su

Prerequisite:

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

Catalog Description:

Differential Calculus- limits, definition of derivative, calculation of derivatives, curve sketching, and applications.

Purpose of Course:
Math 131 is designed to introduce students in the College of Business to differential calculus and related business applications.

Text:

Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences, Haeussler, Wood & Paul, 11th ed.

Topics and Sample Syllabus

Sections	Topics
10.1 (1.1)	Limits
10.2 (1.2)	Limits(con't)
10.4 (1.4)	Continuity
10.5 (1.5)	Continuity Applied to Inequalities
11.1 (2.1)	The Derivative
11.2 (2.2)	Rules for Differentiation
11.3 (2.3)	The Derivative as a Rate of Change
11.5 (2.5)	Product and Quotient Rules
11.6 (2.6)	The Chain Rule and the Power Rule
12.1 (3.1)	Derivatives of the Logarithmic Functions
12.2 (3.2)	Derivatives of Exponential Functions
12.4 (3.4)	Implicit Differentiation
12.5 (3.5)	Logarithmic Differentiation
12.7 (3.7)	Higher Order Derivatives
13.1 (4.1)	Relative Extrema
13.2 (4.2)	Absolute Extrema on a Closed Interval
13.3 (4.3)	Concavity
13.4 (4.4)	Second Derivative Test
13.5 (4.5)	Asymptotes
13.6 (4.6)	Applied Maxima and Minima

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Course Coordinator
Gloria Woods
2005-2006

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

Note: Sp 05 begins Edition 11

Prerequisite:

Mathematics 131 or 151

Catalog Description:

Integral Calculus-Indefinite integration, area and definite integrals, improper integrals, functions of several variables, maxima, and minima.

Purpose of Course:

Math 132 is designed to introduce students in the College of Business to integral and multivariable calculus. The course is problem oriented with emphasis on business applications.

Text:

Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences, 11th edition, by Ernest Haeussler/Richard S. Paul, Chapters 14-15, 17.
Note: Starting Au 05: Introductory Mathematical Analysis taken from the previous text and presented in a customized OSU paperback edition may also be used (with different section numbers).

Topics	Sections
Differentials	14.1
The Indefinite Integral	14.2
Integration with Initial Conditions	14.3
More Integration Formulas	14.4
Techniques of Integration	14.5
Summation	14.6
The Definite Integral	14.7
The Fundamental Theorem of Calculus	14.8
Approximate Integration	14.9
Area	14.10
Area Between Curves	14.11
Consumer Surplus and Producers Surplus	14.12
Integration by Tables	15.3
Differential Equations	15.5
Improper Integrals	15.7
Functions of Several Variables	17.1
Partial Derivatives	17.2
Applications of Partial Derivatives	17.3
Implicit Partial Derivatives	17.4
Higher Order Partial Derivatives	17.5
Maxima and Minima for Functions of Two Variables	17.7
Lagrange Multipliers	17.8

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Course Coordinator:
Sia Wong
2005-2006

Last yr offered

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. Designed for new first quarter freshmen.

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 (8^{th} edition); Varberg, Purcell, Rigdon. 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:
E. Conrad
2005-2006

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:

Contemporary College Algebra and Trigonometry OSU Custom Edition (2005 – 2006), Hungerford

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

Topics List

Sections	Topics
1.1	Graphs
1.2	Solving Equations Graphically Part 1: The Root Method
1.3	Solving Equations Graphically Part 2: The Intersection Method
2.1	First-Degree Equations and Applications
2.2	Quadratic Equations and Applications
2.3	Maximum and Minimum Applications
3.1	Functions
5.1	Exponential Functions
5.2	Applications of Exponential Functions
5.3	Common and Natural Logarithm Functions
5.4	Properties of Logarithms
5.5	Algebraic Solutions of Exponential and Logarithmic Equations
6.1/6.2	Variation & Arclength and Area of a Circular Sector
6.3	Geometry: Similar Triangles
9.1	Trigonometric Functions of Acute Angles
9.2	Applications of Right Triangle Trigonometry
9.3	The Law of Cosines
9.4	The Law of Sines

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Course Coordinator:
Carmen Lefever
2005-2006

Mathematics 150 **5 cr.** **Elementary Functions**
Au, Wi, 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:
Algebra and Trigonometry-Enhanced with Graphing Utilities, Sullivan and Sullivan, 3rd ed.

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

Sections	Topics
2.1	Functions
3.1	Symmetry: Graphing Key Equations
3.2	Properties of Functions
3.3	Library of Functions: Piecewise-Defined Functions
3.4	Graphing Techniques: Transformations
4.1	Power Functions and Models
4.2	Polynomial Functions and Models
4.3	Rational Functions I
4.4	Rational Functions II: Analyzing Graphs
4.5	Polynomial and Rational Inequalities
6.1	One-to-One Functions: Inverse Functions
6.2	Exponential Functions
6.3	Logarithmic Functions
6.4	Properties of Logarithms
6.5	Logarithmic and Exponential Functions
8.1	Angles and Their Measure
8.2	Right Triangle Trigonometry
8.3	Computing the Values of Trigonometric Functions of Given Angles
8.4	Trigonometric Functions of General Angles
8.5	Properties of the Trigonometric Functions: Unit Circle Approach
8.6	Graphs of the Sine and Cosine Functions
8.7	Graphs of the Tangent, Cotangent, Cosecant, and Secant Functions
8.8	Phase Shift: Sinusoidal Curve Fitting
9.1	The Inverse Sine, Cosine, and Tangent Functions
9.2	Inverse Trigonometric Functions (continued)
9.3	Trigonometric Identities
9.4	Sum and Difference Formulas
9.5	Double-Angle and Half-Angle Formulas
9.7	Trigonometric Equations I
9.8	Trigonometric Equations II
11.1	Polar Coordinates
11.2	Polar Equations and Graphs
11.3	Complex Plane: De Moivre's Theorem

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Course Coordinator:
Paul Ponomarev
2005-2006

Mathematics 151 **5 cr.** **Calculus and Analytic Geometry**
Au, Wi, Sp, Su

Prerequisite:

Mathematics 150 (with grade C- or better) 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, Dale Varberg, Edwin J. Purcell, and Steven E. Rigdon, 8th edition, customized for OSU (some text as 03-04 with Just In Time added).

Topics & Sample Syllabus:

Sections	Topics
2.1	Functions and Their Graphs
2.2	Operations on Functions
2.3	Trigonometric Functions
2.4	Introduction to Limits
2.6	Limit theorems involving trig functions
2.7	Limits
2.8	Limits at infinity
2.9	Continuity of Functions
3.1	Slope of a tangent line and instantaneous velocity
3.2	The Derivative
3.3	Rules for finding Derivatives
3.4	Derivatives of Trigonometric Functions
3.5	The Chain Rule
3.6	Leibniz Notation
3.7	Higher-Order Derivatives
3.8	Implicit Differentiation
3.9	Related Rates
3.10	Differentials and Approximations
4.1	Maxima and Minima
4.2	Monotonicity and concavity
4.3	Local Maxima and Minima
4.4	More max-min problems
4.6	Sophisticated Graphing
4.7	The Mean-Value Theorem
5.1	Antiderivatives

Course Coordinator:
T. Kerler
2005-2006

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Mathematics 152 **5 cr.** **Calculus and Analytic Geometry**
Au, Wi, 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, Dale Varberg, Edwin J. Purcell, and Steven Rigdon, 8th edition, customized for OSU.

(Over for Topics List & Sample Syllabus)

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Topics List & Sample Syllabus

Sections	Topics
5.2	Introduction to Differential Equations
5.3	Sums and Sigma Notation
5.4	Introduction to Area
5.5	The Definite Integral
5.6	The First Fundamental Theorem of Calculus
5.7	The Second Fundamental Theorem of Calculus
5.8	Evaluating Definite Integrals
6.1	The Area of a Plane Region
6.2	Volumes of Solids: Slabs, Disks, Washers
6.3	Volumes of Revolution: Shells
6.4	Length of a Plane Curve
7.1	The Natural Logarithm Function
7.2	Inverse Functions and Their Derivatives
7.3	The Natural Exponential Function
7.4	General Exponential and Logarithmic Functions
7.5	Exponential Growth and Decay
7.7	The Inverse Trigonometric Functions and Their Derivatives
8.1	Integration by Substitution
8.2	Some Trigonometric Integrals
8.3	Rationalizing Substitutions
8.4	Integration by Parts
8.5	Integration by Rational Functions
9.1	Indeterminate forms of type 0/0
9.2	Other indeterminate forms
9.3	Improper Integrals: Infinite Limits of Integration
9.4	Improper Integrals: Infinite Integrands

Course Coordinator:
Z. Fiedorowicz
2005-2006

Mathematics 153 **5 cr.** **Calculus and Analytic Geometry**
Au, Wi, Sp, Su

Prerequisite:
Mathematics 152 (C- or better) or 161 or H161

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 by Varberg, Purcell, and Rigdon, 8th edition, customized for OSU.

Topics & Sample Syllabus

Sections	Topics
	INFINITE SERIES:
10.1	Infinite Sequences
10.2	Infinite Series
10.3	Positive Series: The Integral Test
10.4	Positive Series: Other Tests
10.5	Alternating Series, Absolute Convergence, Conditional Convergence
10.6	Power Series
10.7	Operations on Power Series
10.8	Taylor and Maclaurin Series
	CONICS AND POLAR COORDINATES:
12.1	The Parabola
12.2	Ellipses and Hyperbolas
12.3	More on Ellipses and Hyperbolas
12.4	Translation of Axes
12.6	The Polar Coordinate System
12.7	Graphs of Polar Equations
12.6	Calculus in Polar Coordinates
	GEOMETRY IN THE PLANE, VECTORS
13.1	Plane Curves: Parametric Representation
13.2	Vectors in the Plane: Geometric Approach
13.3	Vectors in the Plane: Algebraic Approach
13.4	Vector-Valued Functions and Curvilinear Motion
13.5	Curvature and Acceleration
	GEOMETRY IN SPACE, VECTORS
14.1	Cartesian Coordinates in Three-Space
14.2	Vectors in Three-Space
14.3	The Cross Product
14.4	Lines and Curves in Three-Space
14.5	Velocity, Acceleration, and Curvature
14.6	Surfaces in Three-Space

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Course Coordinator:
W. Luo
2005-2006

Mathematics 151A Au **5 cr. each** **Calculus and Analytic Geometry**
Mathematics 152A Wi
Mathematics 153A Sp
Mathematics 254A Au

Prerequisite:

The prerequisites are the same as those for 151, 152, 153, 254; e.g. for 151A the prerequisite is Math 150 (C- or better) 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 diverse fields and use graphical and numerical, as well as analytical methods.

Follow-up Course:

After finishing 151A students should be encouraged to take Math 152A, 153A and 254A. Students should be able to switch between the "A" sequence and the traditional calculus sequence.

Text:

Calculus, Single and Multivariable, Hughes-Hallett, Gleason, et al., 3rd ed.

Topics:

151A: Chapters 1, 2, 3, and 4. Topics include rational, exponential, logarithmic, and trigonometric functions, and the concept, computation and applications of derivatives, L'Hopital's Rule.

152A: Chapters 5, 6, 7, and 8. Topics include antiderivatives, computation of indefinite and definite integrals, and the concept and applications of integration.

153A: Chapters 9, 10, 12, 13, sections 3.8 and 17.1-17.2, Appendices B and C, cylindrical and spherical coordinates (and 17.3-17.4 if time permits). Topics include approximations and series, functions of several variables, vectors, polar coordinates, and complex numbers.

254A: Chapters 14, 16, (17.3-17.4 if not covered in 153A) 18, 19, and 20. Topics include differentiation and integration of functions of several variables; vector fields; line integrals; and calculus of vector fields.

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Course Coordinator:
H. Lehr
2005-2006

Mathematics 151C	**Au, Wi**	**5 cr. each**	**Calculus and Analytic Geometry**
Mathematics 152C	**Wi, Sp**		
Mathematics 153C	**Sp, Au**		
Mathematics 254C	**Au, Wi**		

Prerequisite:

The prerequisites are the same as those for 151, 152, 153, 254. e.g. for 151C the prerequisite is Math 150 (C- or better) 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 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 Mathematics courses - 255C, 415C, 568C 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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Course Coordinator:
Nela Lakos
2005-2006

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:

Calulus (8^{th} edition customized for OSU); Varberg, Purcell, Rigdon.

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:
TBD
2005-2006

Math 161 A Au **5 cr.** **Accelerated Calculus with**
Math 162 A Wi **Analytic Geometry I, II, III**
Math 263 A Sp

Prerequisite:

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

Catalog Description:

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

162A: Improper integrals, L'Hopital's Rule, polynomial approximations and Taylor's Theorem; infinite sequences and series; tests for convergence; vectors, lines and planes, curves and surfaces in three-space

263A:
Multivariable calculus, line and surface integrals, vector fields.

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 and 161A, 162A, and 163A in 04-05.

Text:

Calculus, D. Varberg, E. J. Purcell and S.E. Rigdon, 8th edition, customized for OSU.

Topics:

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

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Course Coordinator:
Nela Lakos
2005-2006

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 and H521 (or any other courses in linear algebra or differential equations).

Text:

Calculus with Analytic Geometry, 2nd edition, Simmons
NOTE: The textbooks for the Math 161 sequence and Math 151 sequence are not the same as H161.

Topics:

H161. The concept of the limit, continuous functions, differentiation, the Mean Value Theorem, implicit functions, derivatives of higher orders, applications of derivatives, integral calculus of the polynomial, logarithmic, exponential and trigonometric functions, integration techniques and applications.

H162. L'Hospital's rule, improper integrals, sequences and series, convergence tests, power series, Taylor's formula, conic sections, polar coordinates and their applications, parametric equations of curves, vector algebra in the plane and three-dimensional space, derivatives of vector functions, curvature and the unit normal vector, tangential and normal components of acceleration, analytic geometry of three-dimensional space.

H263. Partial derivatives, the tangent plane to a surface, directional derivatives and the gradient, the chain rule for partial derivatives, maximum and minimum problems, Lagrange multipliers, multiple integrals and their applications, cylindrical and spherical coordinates, areas of surfaces, line and surface integrals, Green's theorem, Divergence theorem, Stokes' theorem.

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Course Coordinator:
V. Bergelson
2004-2005

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
2005-2006

Mathematics	**H190 Au**	**5 cr.**	**Elementary Analysis I**
	H191 Wi		**Elementary Analysis II**
	H264 Sp		**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: The first of an enriched honors calculus sequence designed to introduce students to the mathematical underpinnings of analysis.

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 vary, for example:

Calculus, Spivak, 3rd. ed -for H190, H191.
Vector Calculus, 4th edition, Marsden/Tromba- for H264 (used in Spring '00 and Spring '03)
Advanced Calculus of Several Variables, Edwards, Jr. – for H264 (used in Spring '05)
Advanced Calculus, 3rd edition, Buck - for H264 (used in Spring '02)

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
2005-2006

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 by Varberg, Purcell, and Rigdon, 8th edition, customized for OSU.

Topics & Sample Syllabus

Sections	Topics
	THE DERIVATIVE IN n-SPACE
14.7	Cylindrical and Spherical Coordinates
15.1	Functions of Two or More Variables
15.2	Partial Derivatives
15.3	Limits and Continuity
15.4	Differentiability
15.5	Directional Derivatives and Gradients
15.6	The Chain Rule
15.7	Tangent Planes, Approximations
15.8	Maxima and Minima
15.9	LaGrange's Method
	THE INTEGRAL IN n-SPACE
16.1	Double Integrals over Rectangles
16.2	Iterated Integrals
16.3	Double Integrals over Nonrectangular Regions
16.4	Double Integrals in Polar Coordinates
16.5	Applications of Double Integrals
16.6	Surface Area
16.7	Triple Integrals (Cartesian and Coordinates)
16.8	Triple Integrals (Cylindrical and Spherical Coordinates)
	VECTOR CALCULUS
17.1	Vector Fields
17.2	Line Integrals
17.3	Independence of Path
17.4	Green's Theorem in the Plane
17.5	Surface Integrals
17.6	Gauss' Divergence Theorem
17.7	Stokes' Theorem

Course Coordinator:
K. Koenig
2005-2006

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Mathematics 255 **Au, Wi, Sp, Su** **5 cr.** **Differential Equations**
Mathematics 255C **Au, Wi, Sp** **and Their Applications**

Prerequisite:
Mathematics 254. Not open to students with credit for 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 (7^{th} edition, red cover, custom version), Boyce and DiPrima. (Math 255).

Differential Equations & Mathematica, Davis (255C).

Topics & Sample Syllabus

Sections	Topics	Approximate Time
	Introduction	
1.1	Some Basic Mathematical Models; Direction Fields	2 lectures
1.2	Solutions of Some Differential Equations	
1.3	Classification of Differential Equations	
2.2	Separable Equations	
	First Order Differential Equations	
2.1	Linear Equations with Variable Coefficients	6 lectures
2.4	Differences Between Linear and Nonlinear Equations	
2.5	Autonomous Equations and Population Dynamics	
2.6	Exact Equations and Integrating Factors	
2.7	Numerical Approximations: Euler's Method	
2.8	The Existence and Uniqueness Theorem	
	Second Order Linear Equations	
3.1	Homogeneous Equations with Constant Coefficients	5 lectures
3.2	Fundamental Solutions of Linear Homogeneous Equations	
3.3	Linear Independence and the Wronskian	
3.4	Complex Roots of the Characteristic Equation	
3.5	Repeated Roots; Reduction of Order	
3.6	Nonhomogeneous Equations; Method of Undetermined Coefficients	
3.7	Variation of Parameters	

MIDTERM #1

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Topics & Sample Syllabus, cont'd

	Higher Order Linear Equations	
4.1	General Theory of *n*th Order Linear Equations	6 lectures
4.2	Homogeneous Equations with Constant Coefficients	
4.3	The Method of Undetermined Coefficients	
4.4	The Method of Variation of Parameters	
	Series Solutions of Second Order Linear Equations	
5.1	Review of Power Series	6 lectures
5.2	Series Solutions near an Ordinary Point, Part I	
5.3	Series Solutions near an Ordinary Point, Part II	
5.4	Regular Singular Points	
5.5	Euler Equations	
5.6	Series Solutions near a Regular Singular Point, Part I	
5.7	Series Solutions near a Regular Singular Point, Part II	
	MIDTERM #2	
	The Laplace Transform	
6.1	Definition of the Laplace Transform	5 lectures
6.2	Solution of Initial Value Problems	
6.3	Step Functions	
6.4	Differential Equations with Discontinuous Forcing Functions	
6.5	Impulse Functions	
6.6	The Convolution Integral	

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Course Coordinator:
Yuval Flicker
2005-2006

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), algebra (580), 507 and 573. Students may also find Math 345 helpful as preparation for probability (530), 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.

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Course Coordinator:
Neil Falkner
2005-2006

Mathematics 366 | **3 cr.** | **Discrete Mathematical Structures I**
A, W, Sp, Su (1st Term)

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 CS&E 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, 3rd edition

(Over for Topics List)

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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
	RELATIONS
10.1	Relations on Sets
	FUNCTIONS
7.1	Functions Defined on General Sets
7.3	One-to-One and Onto, Inverse Functions
7.5	Composition of Functions

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Course Coordinator:
Timothy Carlson
2005-2006

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

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

Prerequisite:

To be taken concurrently with Aero-Eng 414 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, 7th 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:
Yuan Lou
2005-2006

Mathematics 415 Au, Wi, Sp, Su **4 cr.** **Ordinary and Partial**
Mathematics 415C Au, Wi, Sp **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, 7th edition, Boyce and DiPrima. (415)

Differential Equations & Mathematica, Davis (415C)

(Over for Topics List)

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Topics:

1.1-1.3	Introduction to differential equations, including some applications for motivation
2.1	Linear first order ordinary differential equations (ODEs) and integrating factors
2.2	Separable equations
2.3	Applications of linear equations
2.4	Bernoulli's equation: Differences between linear and nonlinear equations
2.5	Qualitative theory for solving nonlinear ODEs
2.6	Exact equations
3.1	Homogeneous equations with constant coefficients
3.2, 3.3	Fundamental solutions, linear independence, Wronskian
3.4	Complex numbers and complex roots of the characteristic polynomial
3.5	Repeated real roots of the characteristic equation and the method of reduction order
3.6	Nonhomogeneous equations: method of undetermined coefficients
3.7	Nonhomogeneous equations: method of variation of parameters
3.8, 3.9	Vibrations with and without damping and forcing
5.1	Review of power series
5.2	Examples of series solutions near regular points
10.1	Two-point boundary value problems
10.2, 10.3	Fourier series, Fourier convergence theorem
10.4	Fourier series for even and odd functions
10.5	Heat equation with zero boundary conditions
10.6	Heat equation with other boundary conditions
10.7	Wave equation and D'Alembert's solution
10.8	Laplace's equation

Course Coordinator:
Fangyang Zheng
2005-2006

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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:

The text will vary with the Instructor.

Topics:

The topics will vary based on the instructors.

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Course Coordinator:
Bostwick Wyman
2005-2006

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 spherical and hyperbolic geometry to clarify and illustrate the special role played by Euclidean geometry.

Text:

Math 507 course packet

Optional Reference:

Clemens & Clemens, Geometry for the Classroom, Springer Verlag.

Greenberg, Euclidean & Non-Euclidean Geometries, W.H. Freeman & Co.

Topics:

I. Review of Euclidean geometry (resurrect high school geometry as the unique complete, flat, 2-dimensional geometry)
II. Intuitive idea of Riemannian geometry (consider 2-dimensional geometries which are 'curved')
III. Hyperbolic geometry (a negatively curved, complete homogeneous, 2-dimensional geometry)
III. Rigid motions in 2-dimensional geometries (enough of these is what makes the geometry 'homogeneous')
IV. Transformations, linear algebra, linear fractional transformations
V. Spherical geometry (a positively curved, complete homogeneous, 2-dimensional geometry)
VI. Return to Riemannian geometry (curved geometries of various dimensions)

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Course Coordinator:
Herb Clemens
2005-2006

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

Prerequisite:

Mathematics 255 or 415.

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:

Partial Differential Equations and Boundary Value Problems with Fourier Series, 2nd Edition, Asmar.

Topics List & Sample Syllabus

Sections	Topics	Approximate Time
1.1-1.2	Introduction	10 days*
2.1-2.4, 2.6-2.7	Fourier Series	
2.6	Complex Form of Fourier Series (optional)	
2.7	Forced Oscillations	
3.1, 3.3-3.8	Partial Differential Equations**	12 days*
4.1, 4.4(optional)	Laplacian in Polar Coordinates	
4.1 and 5.1(optional)	Laplacian in Spherical Coordinates	
8.1-8.2	Laplace Transforms	
8.2	Application of Laplace Transform to PDE's (or other applications)	

*Including a test

**Only rectangular coordinates are required.

Course Coordinator:
Bong-Sik Kim
2005-2006

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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.

Text:
Introduction to Vector Analysis, Davis and Snider, 7th edition

Possible Alternative Texts:
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	4 days
2.1-2.3 (2.4 optional)	Vector functions of one variable, arc length, Velocity, acceleration, curvature	5 days
3.1-3.6	Vector and scalar functions, Chain Rule, Divergence, gradient and curl, directional derivative, normals, tangent planes	4 days
4.1-4.4, 4.6-4.9,	Line integrals, potentials, surfaces, surface integrals, Green's Theorem, the Divergence Theorem, Stokes' Theorem, potentials, Applications	13 days

Additional Topics (Instructor's Choice) Time Permitting:
This syllabus is based on the Davis and Snider text. This book is well-written but very verbose. It does not include any applied science applications from fluid mechanics or electricity and magnetism, for example.

(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)

Each class should include some applied examples obtained from other textbooks.

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Course Coordinator:
Ulrich Gerlach
2005-2006

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)

Possible Alternative Text:
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:
Fei-Ran Tian
2005-2006

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
2005-2006

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.

H521-H520 with a grade of C or better or written permission of Honors Committee chairperson.

H522-H521 with a grade of C or better or written permission of Honors Committee chairperson.

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.

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:

Autumn: H520
Valenza, Linear Algebra: An Introduction to Abstract Mathematics (1998)
Dettman, Introduction to Linear Algebra and Differential Equations (1999)
Strang, Linear Algebra and Its Applications (2000)
Axler, Linear Algebra Done Right (2001)
Curtis, Linear Algebra: An Introductory Approach (used in 2003, 2004)

Winter: H521
Dettman, Introduction to Linear Algebra and Differential Equations (2000)
Strogatz, Nonlinear Dynamics and Chaos (2001)
Coddington, An Introduction to Ordinary Differential Equations (1999, 2002, 2003)
Simmons, Differential equations with Applications & Historical Notes, 2nd Edition (2005)

Spring: H522
Flanigan, Complex Variables: Harmonic and Analytic Functions (used in Spring '99)
Bak-Newman, Complex Analysis, 2nd edition (used in Spring '01)
Silverman, Complex Analysis with Applications, (used in Spring 2003)

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Course Coordinator:
V. Bergelson
2005-2006

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

Prerequisite:

Mathematics 254.

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.

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
2005-2006

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 P. 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 P in May.

Text:

Actex Publication Review manual for Exam P.

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Course Coordinator:
C. Ban
2005-2006

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

*** Offered in odd years only (Wi 2003, Wi 2005, etc.)**

Prerequisite

Mathematics H263 or H264, H520, H521, or permission of the instructor

Catalog Description

The topology of E^n, differentiation of vector valued functions, inverse and implicit function theorems, Riemann and Lesbegue integration in E^n.

Purpose of Course

The sequence H540, H541 is meant to provide an introduction to differential geometry: the application of the tools of multivariable calculus to the study of manifolds, especially curves and surfaces.

Follow-up course

Math H541.

Texts vary, for example:

Differential Geometry of Curves and Surfaces, DoCarmo, (used Winter 2003)
Elements of Differential Geometry, R. Milman and G. Rarker
Elementary Topics in Differential Geometry, Thorpe (used Winter 2005)

Topics for H540-H541

Geometry of curves, surfaces, and higher dimensional manifolds; curvature; geodesics; the Gauss Bonnet Theorem; mapmaking; Riemannian metrics; non-Euclidean geometries.

Course Coordinator:
V. Bergelson
2005-2006

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

*** Offered in odd years only (Sp 2003, Sp 2005, etc.)**

Prerequisite

Mathematics H540, or permission of the instructor

Catalog Description

Curves and line integrals in E^n , tensor and exterior algebras, differential forms, integration on manifolds, divergence and Stokes' theorem and applications.

Purpose of Course

The sequence H540, H541 is meant to provide an introduction to differential geometry: the application of the tools of multivariable calculus to the study of manifolds, especially curves and surfaces.

Texts vary, for example:

Differential Geometry of Curves and Surfaces, DoCarmo, (used Winter 2003)
Elements of Differential Geometry, R. Milman and G. Rarker
Elementary Topics in Differential Geometry, Thorpe (used Winter 2005)

Topics for H540-H541

Geometry of curves, surfaces, and higher dimensional manifolds; curvature; geodesics; the Gauss Bonnet Theorem; mapmaking; Riemannian metrics; non-Euclidean geometries.

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Course Coordinator:
V. Bergelson
2005-2006

Mathematics 547 **3 cr.** **Introductory Analysis I**
Au, Wi

Prerequisite:

Mathematics 345 or equivalent

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 and inequalities.

Follow-up Course:

Math 548.

Text:

Introduction to Real Analysis, 3rd ed., Bartle/Sherbert

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:
Paul Nevai
2005-2006

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

Text:

Introduction to Real Analysis, 3rd ed., Bartle/Sherbert

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:
Paul Nevai
2005-2006

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.

Text:

Introduction to Real Analysis, 3rd ed., Bartle/Sherbert

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. Integration 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:
Paul Nevai
2005-2006

Mathematics 551 5 cr. Vector Analysis
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 513.

Text:

Vector Calculus, Thomas H. Barr Second Edition.

Topics:

Review of vectors (dot product, cross product), curves, gradient, curl, divergence, line integrals, surface integrals, the Divergence Theorem, Green's Theorem, Stokes' 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 Stokes' theorem.

Sections	Topics	Approximate Time
Chapter 1	Review of vectors (dot product and cross product), lines and planes Vector valued functions, derivatives	2 weeks
4.1 4.2	Gradient Divergence and curl	2 weeks
Chapter 5	Arc length, line integrals, surface area, integrals	6 weeks
Chapter 6	Conservative vector fields, Green's Theorem, Divergence Theorem, Stokes' Theorem	

Other possible topics that could be included are curl and divergence in different coordinate systems e.g. spherical and cylindrical coordinates (from the book Vector Analysis, Davis/Snyder, Section 3.10).

Course Coordinator:
Luis Casian
2005-2006

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

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. Because the course has minimal prerequisites, the emphasis will be on problem solving techniques. This course is not open to students with credit for 514.

Text:

Complex Variables and Applications, Churchill and Brown , Seventh Edition.

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
2005-2006

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 CS&E faculty is for this course to present math in rigorous form and require students to deal with abstract systems and mathematical proofs.

Text:

Discrete Mathematics with Applications, S. S. Epp, 3rd edition.

Topics and Sample Syllabus

Sections Topics

COUNTING
6.1 Introduction
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
6.7 The Binomial Theorem
FLOOR AND CEILING FUNCTIONS
3.5 Direct Proof and Counterexample V: Floor and Ceiling
O-NOTATION
9.1 Real-Valued Functions of a Real Variable and Their Graphs
9.2 O, Omega and Theta Notations
9.3 Application: Efficiency of Algorithms I
9.4 Exponential and Logarithmic Functions: Graphs and Orders
HANDOUT: Summations
RECURSION
8.1 Recursively Defined Sequences
HANDOUT: Recurrence Relations and Orders of Growth.
8.4 General Recursive Definitions
RELATIONS
10.1 Relations on Sets
10.2 Reflexivity, Symmetry, and Transitivity
10.3 Equivalence Relations
10.5 Partial Order Relations
GRAPHS AND TREES
11.1 Graphs: An Introduction
11.2 Paths and Circuits
11.3 Matrix Representations of Graphs
11.4 Isomorphisms of Graphs
11.5 Trees
11.6 Spanning Trees (omit discussion of Kruskal's algorithm and Prim's algorithm)

HANDOUT: Planar Graphs
HANDOUT: Graph Coloring

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Course Coordinator:
Timothy Carlson
2005-2006

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

Prerequisite:
Mathematics 254. Not open to students with credit for 571.

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:
Math 568 is a concrete introduction to linear algebra for (mathematically unsophisticated) students who have completed a four quarter Calculus sequence, and serves as their introduction to Mathematics as a deductive discipline. This being the case, proofs that are computational in nature, that provide a computation, procedure or algorithm that can be readily employed by such students, are strongly preferred. However, the text does have many True/False problems requiring brief (justification)/(counter-example), as well as concrete problems requiring an understanding of the machinery and results that have been developed. Such problems should be included regularly in homework assignments.

Follow-up Course:
None.

Text:
Linear Algebra and its Applications, Lay, Addison-Wesley, 3rd edition.

Topics and Sample Syllabus

Sections	Topics
LINEAR EQUATIONS IN LINEAR ALGEBRA	
1.1	Systems of Linear Equations
1.2	Row Reduction and Echelon Forms
1.3	Vector Equations
1.4	The Matrix Equation
1.5	Solution Sets of Linear Systems
1.7	Linear Independence
1.8	Introduction to Linear Transformations
1.9	The Matrix of a Linear Transformation
MATRIX ALGEBRA	
2.1	Matrix Operations
2.2	The Inverse of a Matrix
2.3	Characterizations of Invertible Matrices
2.8	Subspaces of R^n
2.9	Dimension and Rank
DETERMINANTS	
3.1	Introduction to Determinants
3.2	Properties of Determinants
3.3	Cramer's Rule, Volume, and Linear Transformations
EIGENVALUES AND EIGENVECTORS	
5.1	Eigenvectors and Eigenvalues
5.2	The Characteristic Equation
5.3	Diagonalization
ORTHOGONALITY AND LEAST SQUARES	
6.1	Inner Product, Length, and Orthogonality
6.2	Orthogonal Sets
6.3	Orthogonal Projections
6.4	The Gram-Schmidt Process

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Course Coordinator:
Harry Allen
2005-2006

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

Prerequisite:

Math 254. Not open to students with credit for 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, 3rd edition
Linear Algebra with Applications, S. Leon, 6th 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
2005-2006

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, 3rd edition
Linear Algebra with Applications, S. Leon, 6th 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
2005-2006

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

Prerequisite:

Mathematics H264 or 366 or 345 or Grad standing or permission of department.

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, elliptic curves, higher degree Diophantine equations.

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Course Coordinator:
Paul Ponomarev
2005-2006

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

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 nonalgebraic 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: Introductory Combinatorics, (4th ed.), Richard A. Brualdi

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 Topics List)

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Topics List

What is Combinatorics?

Examples include perfect covers of chessboards, magic squares, the 4-color problem, 36 officers problem, shortest route problem

Permutations and Combinations

Two basic counting principles, permutations and combinations of sets, permutations and combinations of multisets

The Binomial Coefficients

Pascal's formula, the binomial theorem, identities, the multinomial theorem, Newton's binomial theorem

Matchings in Bipartite Graphs

General problem formulation, matchings, systems of distinct representatives

Introduction to Graph Theory

Basic properties, Eulerian trails, Hamilton chains and cycles, bipartite multigraphs, trees

More on Graph Theory

Chromatic number, plane and planar graphs, 5-color theorem

Recurrence Relations & Generating Functions

Some number sequences, linear homogeneous recurrence relations, non-homogeneous recurrence relations, generating functions, recurrences and generating functions, exponential generating functions

Special Counting Sequences

Difference sequences and Stirling numbers, partition numbers

Combinatorial Designs

Block designs, steiner triple system, latin squares

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Course Coordinator:
Thomas Dowling
2005-2006

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

***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 vary, for example:

An Introduction to the Theory of Numbers, G. Hardy and E. Wright
A Course in Number Theory, (2nd edition), H. Rose
A Friendly Introduction to Number Theory, Silverman
An Introduction to the Theory of Numbers, I. Niven, H.S. Zukkerman, H.L. Montgomery

(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. Champernoun'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. Bertrand'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, Cayley's octavas. Hurwitz' Theorem. Minkowski'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
2005-2006

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

Prerequisite:

CS&E 201 or 221, and Mathematics 568, and either Mathematics 530 or Statistics 427.

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 Mathematics (Second Edition) by Norman L Biggs.

Other References:

Discrete Dynamical Systems, Sandefur; Mathematical Modeling, Maki & Thompson; Applying Mathematics, Burghes, Huntly & McDonald; Computer Simulation, Nancy Roberts et al, Addison-Wesley; Applications of Linear Algebra, Anton & Rorres, Wiley; An Introduction to Mathematical Models, Olinick; A variety of different modules available through COMAP; A First Course in Mathematical Modeling, (Second Edition), Giordano, Weir & Fox, Brooks/Cole Publishing Company

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
2005-2006

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.

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Course Coordinator:
R. Solomon
2005-2006

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 written and oral communication skills. We expect that this course will serve as the third writing course for the actuarial science major.

Text:

Actuaries' Survival Guide, Fred E. Szabo, Elsevier, Inc. 2004.

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:
C. Ban
2005-2006

Mathematics	**H590 Au**	**5 cr. each**	**Algebraic Structures I**
	H591 Wi		**Algebraic Structures II**
	H592 Sp		**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 vary, for example:

Algebra, M. Artin
Abstract Algebra, 3rd Edition, D. Dummit and R. Foote (used 2004, 2005)
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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Course Coordinator:
V. Bergelson
2005-2006

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

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 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.

Follow-up Course:

Math 602

Text:

Introduction to Linear Algebra, Johnson, Riess & Arnold, (chapter 4)
Linear Algebra and its Applications, Strang 3rd Edition, (chapter 5)

Website: http://www.math.ohio-state.edu/~gerlach/math

(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 spaces

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)*

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Course Coordinator:
Ulrich Gerlach
2005-2006

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.

Follow-up Course:

Math 603

Possible Texts and Topics:

I. Eigenvalues and eigenvectors:

Linear Algebra and its Applications, Strang, 3rd edition, (Ch. 5, 6, and Appendix A)

II. Infinite-dimensional vector spaces:

III. 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)

IV. **Website: http://www.math.ohio-state.edu/~gerlach/math**

(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)*

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Course Coordinator:
Ulrich Gerlach
2005-2006

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

Prerequisite:

Some complex analysis. Mathematics 514 would be sufficient.

Catalog Description:

An introduction to partial differential equations 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 partial differential equations in 2 and 3 dimensions:
   Partial Differential Equations in Physics, Sommerfeld, (Ch. IV, II)
   Mathematical Methods of Physics, Mathews and Walker, (Ch. 8)

IV. **Website: http://www.math.ohio-state.edu/~gerlach/math**

(over for Topics List)

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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)*

DEPARTMENT OF MATHEMATICS
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Course Coordinator:
Ulrich Gerlach
2005-2006

Mathematics 618 **3 cr.** **Theory of Interest**
Au

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 FM of the Society of Actuaries and the Casualty Actuarial Society. The course is required for the undergraduate major in actuarial science.

Text:

Mathematics of Investment and Credit, 3rd Edition, 2004, Samuel A. Broverman, ASA, Ph.D., Actex Publications.

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.

For further information see:
C. Ban
2005-2006

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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 Society of Actuaries Exams currently under revision.

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 several new Examinations 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
2005-2006

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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.

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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 meant to prepare 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, 99-00, and 00-01)
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
[Out of print, but may be used for reference]
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:
Principles of Mathematical Analysis, 3rd Edition, Rudin

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

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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

(over for topics list and texts)

Possible Texts:

An Introduction to Algebraic Topology, Rotman
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.

Topics List for Math 655/656/657:

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

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Mathematics 665 **4 cr.** **Modern Mathematical Methods**
Mathematics 666 **In Relativity Theory I, II**

Prerequisite:

Multivariable Calculus, Linear Algebra (Mathematics 568 or 571, but preferably Mathematics 601 or its equivalent), "mathematical maturity" (being able to present solutions to problems in a logical and coherent way), a physics course (e.g. Physics 133).

Catalog Description:

665:
Geometry of Minkowski spacetime; physical interpretations; tensors; exterior calculus, manifolds; Lie deriviatives; parallel transport; torsion; curvature; Cartan's two structureal equations; Cartan-Misner calculus.

666:
Energy-momentum tensor; fluid dynamics; Einstein field equations, geometry and dynamics of homogeneous cosmologies; black holes, gravitational collapse, violent astrophysical processes.

Purpose of Course:

To develop an appreciation and the modern machinery for the description of the spacetime continuum with emphasis on (1) the underlying differential geometric framework of spacetime, and (2) the formulation (motivated from classical mechanics, fluid dynamics, and wave mechanics) for identifying its properties. To provide, among others, an introduction for independent work dealing with geometric dynamical processes (particle, wave, fluid, hydro) in flat or curved spacetime.

Text:

Gravitation by C.W. Misner, K.S. Thorne, and J.A. Wheeler
Spacetime Physics by E. Taylor and J.A. Wheeler
Mathematical Methods of Classical Mechanics by V.I. Arnold
Lecture Notes on Elementary Topology and Geometry by I.M. Singer

(Over for Topics List)

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Topics:

665:
A rapid course in special relativity
Fermi-Walker transport
Lorentz geometry, accelerated frames and event horizons
The acceleration temperature
Tensors (multilinear algebra)
Metric geometry vs symplectic geometry
Exterior calculus
Maxwell field equations
Manifolds
The rotation group SO(3)
Lie derivatives
Parallel transport
Torsion
Curvature
Jacobi's equation of geodesic derivation
Cartan's two structural equations
Metric induced properties
Cartan-Misner curvature calculus

666:
Geodesics as external curves
Geodesics as the bridge between physics and geometry
The stress-energy tensor
Conservation of energy and momentum
Perfect fluids
Hydrodynamics in curved spacetime
Scalar and vectorial form of Stoke's theorem
The Bianchi identities
The moment of rotation
The integral form of Einstein's field equations
Conservation of energy-momentum and the vanishing of the boundary of a boundary
Einstein's equations and its solutions for spherically symmetric configurations
Neutron stars
Hamilton-Jacobi theory and the principle of constructive interference
Hamilton-Jacobi analysis of relativistic and Keplerian particle orbits around a black hole
Geometry and dynamics of the universe
Scalar, vector, and tensor harmonics on the two-sphere
Acoustic and gravitational waves in violent relativistic backgrounds
Gauge invariant perturbation theory on spherically symmetric spacetimes

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Mathematics	**670 Au**	**5 cr. each**	**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. Student should feel comfortable with "proofs".

Catalog Descriptions :

670:
Examples of groups, subgroups, quotient groups, isomorphism theorems, group actions, class equation, automorphisms, Sylow theorems, direct products, finitely generated abelian groups, introduction to rings and ring homomorphisms, ideals, quotient rings, Chinese remainder theorem. (Chapters 1-5 and 7 in Dummit/Foote were covered in last two years).

671:
Continuation of 670: Euclidean domains, principal ideal domains, unique factorization domains, polynomial rings, basics of modules over commutative rings (esp. over PIDs), canonical forms for matrices.
(Chapters 8, 9, 10-12 but skip tensor products, exact sequences, tensor, symmetric and exterior algebras)

672:
Continuation of 671: Algebraic extension of fields, ruler and compass constructions, splitting fields, algebraic cosures, cyclotomic polynomials, galois theory for characteristic zero fields, finite fields.

Purpose of Course:

Standard entry course for M.S. students in mathematics. A basic aimis to prepare background for Qualifying Examination in Algebra.

Text:

Abstract Algebra, Dummit & Foote (used 1995, 2002, 2003)
or
Algebra, Artin (used 1992, 1993, 1994)
or
Topics in Algebra, Herstein.

(Over for Topics List and Sample Syllabus)

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Topics List & Sample Syllabus:

(Sample syllabus was based on Dummit/Foote used in 2002 and 2003)

Topics	Approximate Time
670:	
Chapters 1 – 5	8 weeks
Chapter 7	2 weeks
671	
Chapter 8	3 weeks
Chapter 9 (9.1 – 9.5)	2.5 weeks
Chapter 10 (10.1 – 10.4)	
Chapter 11 (11.1 – 11.4)	
Chapter 12	4.5 weeks
672	
Chapter 13 (skip inseparable extensions)	
Chapter 14 (skip transcendental extensions and infinite galois extensions)	

Course Coordinator:
R. Solomon
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Mathematics 701 **5 cr. Ea** **Mathematical Principles in Science III:**
Wi (Alternate Years) **Calculus of Variations & Tensor Calculus**

Prerequisite:
Math 601 or permission of the department.

Catalog Descriptions:

Introduction to tensor analysis with applications to geometry; elements of the calculus of variations with applications to physical problems.

Purpose of Course:

To develop the mathematical framework surrounding the mechanics of particles and of elastic and fluid media. The development will focus on (1) the important extremum principles in physics, engineering, and mathematics and on (2) the modern mathematical description for the kinematics and dynamics of continuous media.

Texts vary, for example:

Calculus of Variations by I.M. Gelfand and S.V. Fomin
Selected sections from Gravitation by C.S. Misner, K.S. Thorne, and J.A. Wheeler

(Over for Topics List)

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Topics:

(I)
Classical problems in the calculus of variations
Euler's equation
Constraints and isoperimetric problems
Variable end point problems
Geodesics
Hamilton's principle, Lagrange's equations of motion
Hamilton's equations of motion, phase space
Action as the dynamical phase of a wave, the equation of Hamilton and Jacobi
Particle motion in the field of two attractive centers
Helmholtz's equation in arbitrary curvilinear coordinates
Rayleigh's quotient and the Rayleigh-Ritz method

(II)
Vectors, covectors and reciprocal vectors
Multilinear algebra
Tensors and tensor products
Commutator of two vector fields
Parallel transport of vectors on a manifold, the covariant differential
Derivative of vectors and tensors
Strain-induced parallel transport in an elastic medium
Strain as a deformation in the metric
Parallel transport induced by a metric
Curvature
Tidal acceleration and the equation of geodesic deviation

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