Department of Mathematics
The Ohio State University

2007-2008 Mathematics Courses

Course Number	Course Title
50	Pre-College Mathematics I
75	Pre-College Mathematics II
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
148	Algebra and Trigonometry and Their Applications
150	Elementary Functions
151	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
152	Calculus and Analytic Geometry
153	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
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

Course Number	Course Title
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
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 Euclidean 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
576H	Number Theory Through History I
577H	Number Theory Through History II
578	Discrete Mathematical Models
580	Algebra I
581	Algebra II

Course Number	Course Title
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
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 II
670	Algebra I
671	Algebra II
672	Algebra III
701	Mathematical Principles in Science III: Calculus of Variations & Tensor Calculus

Mathematics 050　　　　　　　　**5 cr.**　　　　　　　　**Pre-College Mathematics I**
A, W, Sp, Su

Prerequisite:

Course Code T on Math Placement Test. Not open to students with credit for any higher numbered math course.

Catalog Description:

Arithmetic of integers and fractions, linear equations in one variable, coordinates and introductory graphing, polynomial arithmetic, factoring and equation solving.
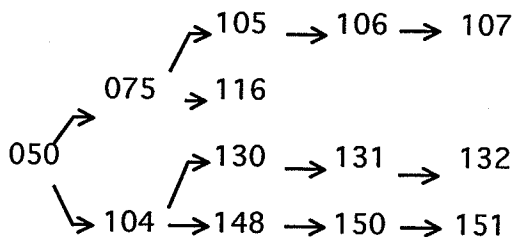
Purpose of Course:

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 and 075 or 050 and 104.

Follow-up Course:

Math 075 or Math 104

Sequencing Chart:

```
                   →105 → 106 → 107
              /
        075  →116
      /
  050
      \
        →104 →148 →150 → 151
                   →130 → 131 → 132
              /
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Text:

Beginning Algebra (4th ed.) by K. Elayn Martin-Gay (Prentice Hall), Chapters 1 – 6 (omit Chapter 4).

Continued.

Mathematics 050
Page 2

Topics List

Sections	Topics
1.1-1.8	**REVIEW OF REAL NUMBERS**

Mathematics 050
Page 2

Topics List

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*

Course Coordinator
C. Roman
2007-2008

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

Prerequisite:

Mathematics 050, or Course Code S on Math Placement Test. Not open to students with credit for any math course except 050.

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:
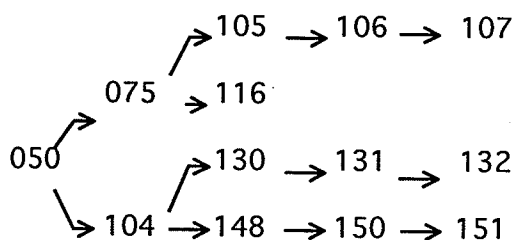
Text:

Beginning Algebra, 4th edition, Martin-Gay, Prentice-Hall, 0-131-62293-5

Continued.

DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
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COLUMBUS, OHIO 43210-1174

Course Coordinator
B. McEnnis
2007-2008

Topics List & Sample Syllabus

Sections	Topics

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

6.1–6.2   Factoring polynomials
- Greatest common factor and factoring by grouping
- Factoring trinomials

Review and first midterm

6.3–6.5   Factoring polynomials
- Factoring trinomials
- Factoring binomials
- Solving quadratic equations by factoring

7.1–7.6   Rational expressions
- Simplifying rational expressions
- Multiplying and dividing rational expressions
- Adding and subtracting rational expressions
- Least common denominator
- Solving equations containing rational expressions
- Ratio and proportion
- Rational equations and problem solving
- Proportion and problem solving with rational expressions

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
B. McEnnis
2007-2008

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 130 or 148 or 150 or 151.

Catalog Description:

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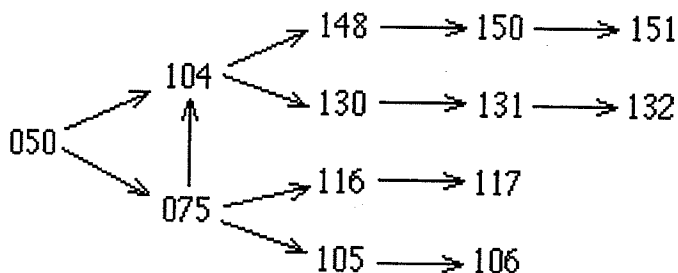
Purpose of Course:

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 0-073-30491-3.

Alternate textbook: Intermediate Algebra, The Language and Symbolism of Mathematics, 1st edition, Hall and Mercer, ISBN 0-073-22968-3.

Continued.

Course Coordinator
R. Aboughazi
2007-2008

Topics List

Section	Topics
2.2	Functions and Representation of Functions
2.3/2.4	Linear Functions and Slope of a Line
2.5/2.6	Linear Equations, and Graphs of Linear and Absolute Value Functions
3.2	Solving Systems of Linear Equations in Two Variables Graphically and Numerically
3.3/3.4	Solving Systems of Linear Equations using the Substitution and Addition Method
3.5	More Applications of Linear Systems
4.1	Linear Inequalities in One Variable
4.2	Compound Inequalities
4.3	Absolute Values Equations and Inequalities

Review and Exam 1

5.4	An Introduction to Factoring
5.5	Factoring Trinomials
5.6	A General Strategy for Factoring Polynomials
5.7	Solving Equations by Factoring
6.1/6.2	Quadratic Functions, and Quadratic Equations and inequalities
6.3	Using the Quadratic Formula to Find Real Solutions
6.4	More Application of Quadratic Equations
6.5/6.6	Complex Numbers and Quadratic Equations with Complex Solutions

Review and Exam 2

7.1	Properties of Graphs of Rational Functions and Reducing Rational Expressions
7.2/7.3	Operations on Rational Expressions
7.4	Combining Operations and Simplifying Complex Rational Expressions
7.6	Equations Containing Rational Expressions
8.1	Evaluating Radical Expressions and Graphing Square Root and Cube Root Functions
8.2	Adding and Subtracting Radical Expressions
8.3	Multiplying and Dividing Radical Expressions
8.4	Equations Containing Radical Expressions

Review and Exam 3

8.5	Rational Exponents and Radicals

Course Coordinator
R. Aboughazi
2007-2008

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, Second Edition, (2008) by Sybilla Beckmann, Pearson/Addison-Wesley.
and
Mathematics for Elementary Teachers: Activities Manual, Second Edition, (2008) by Sybilla Beckmann, Pearson/Addison-Wesley.

Topics List

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
B. McNeal
2007-2008

| 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:

Follows Math 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, Second Edition, (2008) by Sybilla Beckmann, Pearson/Addison-Wesley.
and
Mathematics for Elementary Teachers: Activities Manual, Second Edition, (2008) by Sybilla Beckmann, Pearson/Addison-Wesley.

Topics List

I.   Geometry
II.   Geometry of motion and change
III.   Measurement
IV.   More about Area and volume

Course Coordinator
B. McNeal
2007-2008

Mathematics 107   **5 cr.**   **Topics in Mathematics**
Au, 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, First or Second Edition, by Sybilla Beckmann, Pearson/Addison-Wesley.
and
Mathematics for Elementary Teachers: Activities Manual, First or Second Edition, by Sybilla Beckmann, Pearson/Addison-Wesley.

*The second edition of each book will be required in Spring 2008.

Topics List:

I.   Number Theory
II.   Combinatorial Counting
III.   Probability
IV.   Functions and Algebra

Course Coordinator
B. McNeal
2007-2008

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, 6th edition, Tannenbaum

Continued.

Course Coordinator
R. deLaubenfels
2007-2008

Topics List chosen from the following:

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, linear growth models, simple and compound interest.

Counting
Counting principles, permutations and combinations.

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

Probability
Binomial probability, Pascal's triangle, multiplication rule.

Labs:

Labs involving logarithms, similar triangles, and Moebius strips.

Course Coordinator
R. deLaubenfels
2007-2008

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 250 Mathematics Bldg.

Text:

Single Variable Calculus: Concepts and Contexts, by James Stewart, 3rd edition, 2005, 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 and TI-84. NOTE: The TI-89, TI-92, and any calculator that uses a Computer Algebra System are not allowed in this course.

Continued.

Course Coordinator
V. Ferdinand
2007-2008

Topics List & Sample Syllabus

| 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, 2nd OSU custom edition, by Haeussler, Paul & Wood, Prentice-Hall, ISBN 0-536-10211-2

Alternate Text: Introductory Mathematical Analysis for Business, Economics & the Life Sciences, 12th edition, by Haeussler, Paul & Wood, Prentice-Hall, ISBN 0-132-40422-2

Topics List & 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
5.4	Annuities
5.5	Loans and Amortization

Course Coordinator
S. Sehgal
2007-2008

Mathematics 131
Au, Wi, Sp, Su

4 cr.   **Mathematical Analysis for Business II**

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, 2nd OSU custom edition, by Haeussler, Wood & Paul, Prentice-Hall, ISBN 0-536-98120-5.

Alternate Text: Introductory Mathematical Analysis for Business, Economics & the Life Sciences, 12th edition, by Haeussler, Paul & Wood, Prentice-Hall, ISBN 0-132-40422-2

Topics List and Sample Syllabus

Sections	Topics
10.1	Limits
10.2	Limits (cont.)
10.3	Continuity
10.4	Continuity Applied to Inequalities
11.1	The Derivative
11.2	Rules for Differentiation
11.3	The Derivative as a Rate of Change
11.4	Product and Quotient Rules
11.5	The Chain Rule and the Power Rule
12.1	Derivatives of the Logarithmic Functions
12.2	Derivatives of Exponential Functions
12.4	Implicit Differentiation
12.5	Logarithmic Differentiation
12.7	Higher Order Derivatives
13.1	Relative Extrema
13.2	Absolute Extrema on a Closed Interval
13.3	Concavity
13.4	Second Derivative Test
13.5	Asymptotes
13.6	Applied Maxima and Minima

Course Coordinator
S. Wong
2007-2008

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

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, 2nd OSU custom edition, by Haeussler, Wood & Paul, Prentice-Hall, ISBN 0-536-98120-5, for Winter 2008 and beyond.

Alternate Text: Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences, 11th edition for Au07, then 12th edition, by Haeussler, Paul & Wood, Prentice-Hall, ISBN 0-132-40422-2, Chapters 14-15, 17.

Continued.

Topics List

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

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 and logarithmic equations.

Purpose of Course:

To help students make the transition from abstract mathematics to concrete applications, while 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 (2007 – 2008), Hungerford

Technology: All students are required to have a graphing calculator, TI-83 or TI-84.

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
3.2	The Art of Estimating
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 & Arc Length 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

Course Coordinator
E. Conrad
2007-2008

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:

Precalculus – Mathematics for Calculus, 5[th] OSU custom edition, by Stewart, Redlin and Watson, Thomson, ISBN 0-495-42084-0

Alternate Textbook: Precalculus – Mathematics for Calculus, 5[th] edition, by Stewart, Redlin and Watson, Thomson, ISBN 0-534-49277-0.

Technology:

All students are required to have a graphing calculator. Most instructors will be familiar with the Texas Instruments TI-83 and TI-84.

Continued.

DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
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Course Coordinator
P. Ponomarev
2007-2008

Mathematics 150
Page 2

Topics List:

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:

<u>Calculus Early Transcendentals, Volume 1</u>, OSU custom edition, by James Stewart, Thomson, ISBN 0-495-29488-8.

Alternate Text: <u>Calculus Early Transcendentals</u>, 5th edition, by James Stewart, Thomson, ISBN 0-534-39321-7.

Supplementary Text: <u>Just-In-Time: Algebra and Trigonometry for Students of Calculus</u>, 3rd edition, by G. Mueller, R.I. Brent, Addison Wesley, ISBN 0-321-26943-8

Continued.

DEPARTMENT OF MATHEMATICS
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COLUMBUS, OHIO 43210-1174

Course Coordinator
T. Kerler
2007-2008

Topics List & Sample Syllabus:

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 & Multivariable EGrade Combination with Student Solutions Manual & Syllabus, Hughes-Hallett, Gleason, et al., 4rd edition, Wiley, ISBN 0-471-78820-1.

Topics List

151A:

Section	Title	Section	Title
1.1	Functions & Change	3.1	Powers & Polynomials
1.2	Exponential Functions	3.2	The Exponential Function
1.3	New Functions From Old	3.3	The Product & Quotient Rules
1.4	Logarithmic Functions	3.4	The Chain Rule
1.5	Trigonometric Functions	3.5	The Trigonometric Functions
1.6	Powers, Polynomials, & Rational Functions	3.6	The Chain Rule & Inverse Functions
1.7	Introduction to Continuity	3.7	Implicit Functions
1.8	Limits	3.9	Linear Approximation & The Derivative
2.1	How Do We Measure Speed?	3.10	Theorems About Differentiable Functions
2.2	The Derivative At A Point	4.1	Using First & Second Derivatives
2.3	The Derivative Function	4.2	Families of Curves
2.4	Interpretations Of The Derivative	4.3	Optimization
2.5	The Second Derivative	4.4	Applications to Marginality
2.6	Differentiability	4.5	Optimization & Modeling
4.6	Rates & Related Rates		

Continued.

Mathematics 151C   Au, Wi   5 cr. each   Calculus and Analytic Geometry
Mathematics 152C   Wi, Sp
Mathematics 153C   Sp, Au
Mathematics 254C   Au, Wi
Sequence may be discontinued beginning W08. *along with Calculus Remote (CROSU - for h.s. students)*

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 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, Matheverywhere Inc, ISBN 1-579-55013-4.

For 151C: Calculus & Mathematica: Growth
For 152C: Calculus & Mathematica: Accumulation
For 153C: Calculus & Mathematica: Approximations
For 254C: Calculus & Mathematica: 2D and 3D Measurements

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Course Coordinator
N. Lakos
2007-2008

Mathematics 152   **5 cr.**   **Calculus and Analytic Geometry**
Au, Wi, Sp, Su

Prerequisite:

Mathematics 151 (with grade of C- or better).

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: Early Transcendentals, Stewart, 5th OSU custom edition, Thomson, ISBN 0-495-29488-8.

Alternate Text: Calculus: Early Transcendentals, Stewart, 5th edition, Thomson, ISBN 0-534-39321-7.

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Course Coordinator
Z. Fiedorowicz
2007-2008

Topics List & Sample Syllabus

Mathematics 153
Au, Wi, Sp, Su

5 cr.

Calculus and Analytic Geometry

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:

<u>Calculus: Early Transcendentals, Volume 2</u>, Stewart, OSU custom edition, Thomson, ISBN 0-495-41692-4

Alternate Text: <u>Calculus: Early Transcendentals</u>, Stewart, 5th edition, Thomson, ISBN 0-534-39321-7

Continued.

Topics & Sample Syllabus

Sections	Topics
10.1	Curves Defined by Parametric Equations
10.2	Calculus with Parametric Curves
10.3	Polar Coordinates
10.4	Areas and Lengths in Polar Coordinates
11.1	Sequences
11.2	Series
11.3	The Integral Test and Estimates of Sums
11.4	The Comparison Tests
11.5	Alternating Series
11.6	Absolute Convergence, and the Ratio and Root Tests
11.8	Power Series
11.9	Representations of Functions as Power Series
11.10	Taylor and MacLaurin Series
11.11	The Binomial Series
11.12	Applications of Taylor Polynomials
12.1	Three-Dimensional Coordinate Systems
12.2	Vectors
12.3	The Dot Product
12.4	The Cross Product
12.5	Equations of Lines and Planes
12.6	Cylinders and Quadric Surfaces
12.7	Cylindrical and Spherical Coordinates
13.1	Vector Functions and Space Curves
13.2	Derivatives and Integrals of Vector Functions
13.3	Arc Length and Curvature
13.4	Motion in Space: Velocity and Acceleration

Mathematics 161 Au	5 cr. each	Accelerated Calculus
Mathematics 162 Wi		with Analytic Geometry
Mathematics 263 Sp		

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, if completed 345 concurrently with 263.

Continued.

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Course Coordinator
U. Gerlach
2007-2008

Text:

Calculus Early Transcendentals, Volume 1, OSU custom edition, by James Stewart, Thomson,
ISBN 0-495-29488-8.

Alternate Text: Calculus Early Transcendentals, 5th edition, by James Stewart, Thomson,
ISBN 0-534-39321-7.

*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
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2007-2008

Mathematics 161 A	Au	5 cr.	Accelerated Calculus with
Mathematics 162 A	Wi		Analytic Geometry I, II, III
Mathematics 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, L'Hopital's Rule, the integral, techniques of integration, applications of the integral.

162A:
Improper integrals, 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. They were officially renamed 161G, 162G, 263G in 97-98 and 161A, 162A, and 163A in 04-05.

Text:

Calculus/Early Transcendentals, Stewart, 5th edition, Volumes 1 and 2.

Topics:

Generally, the first quarter does the equivalent of 151 and 152; the second quarter covers 153; and the third quarter covers 254, and some additional topics.

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Course Coordinator
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2007-2008

Mathematics H161 Au	5 cr.	Accelerated Calculus
Mathematics H162 Wi		with Analytic Geometry
Mathematics H263 Sp		

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 concurrently with 345, students will be ready for Math H520, H521 and H522 (or various other courses in linear algebra, analysis 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
2007-2008

Mathematics H187   **2 cr.**   **Advanced Problem Solving**
Mathematics H487
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. It is preparation for the National Putnam Mathematics Exam. 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.

Mathematics	H190 Au	5 cr.	Elementary Analysis I
Mathematics	H191 Wi		Elementary Analysis II
Mathematics	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:
H190, H191: Calculus, Spivak, 3rd edition
H264: Advanced Calculus, Folland (used Sp06, Sp07)
H264: Advanced Calculus of Several Variables, Edwards, Jr. (used Sp05)
H264: Vector Calculus, 4th edition, Marsden/Tromba (used Sp00, Sp03)
H264: Advanced Calculus, 3rd edition, Buck (used Sp02)

Continued.

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Course Coordinator
V. Bergelson
2007-2008

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.

Course Coordinator
V. Bergelson
2007-2008

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: Early Transcendentals, Volume 2, Stewart, 5th OSU custom edition, by James Stewart, Thomson, ISBN 0-495-29488-8.

Alternate Text: Calculus: Early Transcendentals, Stewart, 5th edition, by James Stewart, Thomson, ISBN 0-534-39321-7.

Continued.

Course Coordinator
K. Koenig
2007-2008

Topics List & Sample Syllabus

Week	Sections	Topics
1	14.1	Functions of Several Variables
	14.2	Limits and Continuity
	14.3	Partial Derivatives
2	14.4	Tangent Planes and Linear Approximations
	14.5	The Chain Rule
	14.6	Directional Derivatives and the Gradient Vector
3	14.7	Maximum and Minimum Values
	14.8	Lagrange Multipliers
	---	*Review
4	---	*Midterm 1
	15.1	Double Integrals over Rectangles
	15.2	Iterated Integrals
5	15.3	Double Integrals over General Regions
	15.4	Double Integrals in Polar Coordinates
	15.5	Applications of Double Integrals
6	15.6	Surface Area
	15.7	Triple Integrals
	15.8	Triple Integrals in Cylindrical and Spherical Coordinates
7	15.9	Change of Variables in Multiple Integrals
	---	*Review
	---	*Midterm 2
8	16.1	Vector Fields
	16.2	Line Integrals
	16.3	The Fundamental Theorem for Line Integrals
9	16.4	Green's Theorem
	16.5	Curl and Divergence
	16.6	Parametric Surfaces and Their Areas
10	---	*Review for final
		OR: 16.7-16.9 (Stokes' theorem, divergence theorem)

Course Coordinator
K. Koenig
2007-2008

Mathematics 255   Au, Wi, Sp, Su   5 cr.   **Differential Equations**
Mathematics 255C * Au, Wi, Sp   **and Their Applications**
(* *255C may be discontinued Wi08.*)

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:
Math 255: <u>Elementary Differential Equations and Boundary Value Problems</u> (7th edition, red cover, custom version), Boyce and DiPrima
Math 255C: Differential <u>Equations & Mathematica</u>, Davis

Topics List & 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	

Continued.

Topics List & Sample Syllabus, cont'd

3.5	Repeated Roots; Reduction of Order	
3.6	Nonhomogeneous Equations; Method of Undetermined Coefficients	
3.7	Variation of Parameters	

MIDTERM #1

Higher Order Linear Equations

4.1	General Theory of nth 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
Y. Flicker
2007-2008

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 that 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), 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.
Check out the "study tips" at www.math.ohio-state.edu/students

Course Coordinator
N. Falkner
2007-2008

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

Prerequisite:

Mathematics 132 or 152.

Catalog Description:

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

Purpose of Course:

To provide the foundation for a deeper understanding of the conceptual tools in computer science. Computers, however, are not used in this course. The desire of the 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

Continued.

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Course Coordinator
T. Carlson
2007-2008

Topics List & Sample Syllabus:

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T. Carlson
2007-2008

Mathematics 415   Au, Wi, Sp, Su   4 cr.   Ordinary and Partial
Mathematics 415C * Au, Wi, Sp   Differential Equations
(415C may be discontinued Wi08.)*

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)

Continued.

Course Coordinator
F. Zheng
2007-2008

Topics List:

Section	Topic
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
F. Zheng
2007-2008

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.

Course Coordinator
B. Wyman
2007-2008

Mathematics 507 **5 cr.** **Advanced Geometry**
Au, Wi

Prerequisite:

1) Mathematics H264 or Mathematics 254 and 345
2) Mathematics 568 or GRAD standing

Catalog Description:

Spherical geometry, hyperbolic geometry and advanced topics from Euclidean Geometry.

Purpose of Course:

This course explores all the two-dimensional geometries of constant curvature, beginning with advanced topics in Euclidean geometry, then extensively treating spherical and hyperbolic geometry.

Text:
Math 507 course packet.

Optional Reference:

1) Clemens, H., and Clemens, M. Geometry for the Classroom. Springer Verlag.
2) McCleary, J. "Trigonometries." Amer. Math. Monthly 109(2002), 623-638.

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)
IV. Rigid motions in 2-dimensional geometries (enough of these is what makes the geometry 'homogeneous')
V. Transformations, linear algebra, linear fractional transformations
VI. Spherical geometry (a positively curved, complete homogeneous, 2-dimensional geometry)
VII. Return to Riemannian geometry (curved geometries of various dimensions)

Course Coordinator
H. Clemens
2007-2008

| 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.

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, 7[th] edition

Possible Alternative Texts:
Advanced Engineering Mathematics, Kreyszig, 8[th] edition
Div, Grad, Curl and All That, Schey; and Schaum's outline Vector Analysis

Topics List & 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.

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

Course Coordinator
U. Gerlach
2007-2008

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
F. Tian
2007-2008

Mathematics	H520 Au	5 cr. each	**Linear Algebra**
Mathematics	H521 Wi		**Differential Equations**
Mathematics	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, 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
Strang, Linear Algebra and Its Applications (2000)
Curtis, Linear Algebra: An Introductory Approach (used Au03-Au07)

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 Sp99)
Bak-Newman, Complex Analysis, 2nd edition (used Sp01, Sp05, Sp06)
Silverman, Complex Analysis with Applications, (used Sp03)
H. Cartern, Elementary Theory of Analytic Functions of One or Several Complex Variables,
(used Sp07)

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Course Coordinator
V. Bergelson
2007-2008

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

Course Coordinator
N. Falkner
2007-2008

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
2007-2008

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

* Offered in odd years only (Wi 2007, Wi 2009, 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 Wi03)
Elements of Differential Geometry, R. Milman and G. Rarker
Elementary Topics in Differential Geometry, Thorpe (used Wi05)
A First Course in Geometric Topology and Differential Geometry, E. Bloch (used Wi07)

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
2007-2008

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

* Offered in odd years only (Sp 2007, Sp 2009, 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 Sp03)
Elements of Differential Geometry, R. Milman and G. Rarker
Elementary Topics in Differential Geometry, Thorpe (used Sp05)
A First Course in Geometric Topology and Differential Geometry, E. Bloch (used Sp07)

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
2007-2008

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.

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
P. Nevai
2007-2008

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.

Course Coordinator
P. Nevai
2007-2008

| Mathematics 551 | 5 cr. | Vector Analysis |

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	Gradient	2 weeks
4.2	Divergence and curl	
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).

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Course Coordinator
S. Tanveer
2007-2008

Mathematics 552 **5 cr.**		**Introduction to the Theory of**
Su *(has not been offered since Su 04)*		**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.

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

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 List 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

Course Coordinator
T. Carlson
2007-2008

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: A Modern Introduction, Poole, Thompson, 2nd Edition.

Sample Syllabus:
Chapter 1 Vectors (one week, review)
1.1 Geometry and Algebra of Vectors
1.2 Dot Product
1.3 Lines and Planes

Chapter 2 Systems of Linear Equations
(1 ½ weeks)
2.1 Systems of Linear Equations
2.2 Solving Linear Systems
2.3 Spanning Sets and Linear Independence
2.4 One application (ad libitum)

Chapter 3 Matrices (2 weeks)
3.1 Matrix operations
3.2 Matrix algebra
3.3 Matrix inverse
3.5 Subspaces, basis, l dimension and rank
3.6 Linear transformations

Chapter 4 Eigenvalues and Eigenvectors
(2 ½ weeks)
4.1 Intro to eigenvalues and eigenvectors
4.2 Determinants
4.3 Eigenvalues and eigenvectors of an nxn matrix
4.4 Similarity and Diagonalization
4.6 An application or two (ad libitum)

Chapter 5 Orthogonality (2 weeks)
5.1 Orthogonality in R^n
5.2 Complements and Projections
5.3 The Gram Schmidt Process
5.4 Symmetric Matrices
7.3 Least Squares Approximation
7.4 Singular Value Decomposition (if time permits)

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, 7th 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

Course Coordinator
E. Overman
2007-2008

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:

<u>Linear Algebra Labs with Matlab</u>, Hill & Zitarelli, 3rd edition
<u>Linear Algebra with Applications</u>, S. Leon, 7th edition

Topics List:

This is a continuation of 571. Chapter 5 of Leon's book will be completed, and Chapters 4 and 6 are 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

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.

Course Coordinator
P. Ponomarev
2007-2008

Mathematics 575   **5 cr.**   **Combinatorial Mathematics & Graph Theory**
Wi, Sp (of even numbered years)

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
Finite projective planes
Block designs
Symmetric block designs.

Continued.

Topics List - Cont.

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

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

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

Prerequisite:

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

Catalog Description:

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

H577:
Continuation of H576.

Purpose of Course:

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

Texts vary, for example:

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

Continued.

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.).

Course Coordinator
V. Bergelson
2007-2008

Mathematics 578   **5 cr.**   **Discrete Mathematical Models**
Au, Sp
(has not been offered since Au 04, however Sp class is still held)

Prerequisite:

CS&E 201, 202, or 221, and Mathematics 568, and either Mathematics 530 or Statistics 427 or 420.

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

Continued.

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. Suggested topics:

1. Discrete deterministic models developed from numerical data.
2. Markov processes
3. Random processes and Monte Carlo simulation.
4. Graph theory, including shortest paths, minimum weight spanning trees, and job scheduling.
5. Network flows and the Ford-Fulkerson algorithm for maximum flow.
6. 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.

Course Coordinator
D. Ray-Chaudhuri
2007-2008

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

Prerequisite:

580: Mathematics 568 (may be taken concurrently with 580) and Mathematics 345.
581: Mathematics 580 or H590
582: Mathematics 581 or H591

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, 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:

Pinter, Charles C., <u>A Book of Abstract Algebra</u>, 2nd edition. McGraw-Hill, 1990. ISBN 0-07-050138-6

Topics:

580: Groups; Group actions and symmetry.

581: Rings and Polynomials; Number systems; Elementary Number Theory.

582: Field extensions; Introduction of Galois Theory.

The Wi08 580 topic was group theory, out of Pinter, A Book of Abstract Algebra.
I covered sections 1 through 12, 14, and part of 13.
Topics: definition and basic properties of groups, subgroups, functions and permutations, the symmetric groups, cyclic groups and element orders, homomorphisms and isomorphisms, equivalence relations and cosets, groups of integers mod n,

Joe

| Dear Dr. Ferrar,

Prerequisite:

3^{rd} 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.

Course Coordinator
C. Ban
2007-2008

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

Prerequisite:

H590: H520 with a grade of C or better, or written permission of Honors Committee Chair
H591: H590 with a grade of C or better, or written permission of Honors Committee Chair
H592: H591 with a grade of C or better, or written permission of Honors Committee Chair

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 '04-'07)
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.

Continued.

Course Coordinator
V. Bergelson
2007-2008

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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COLUMBUS, OHIO 43210-1174

Course Coordinator
V. Bergelson
2007-2008

Mathematics 601	3 cr.	Mathematical Principles
Au		in Science I

Prerequisites:

Several quarters of mathematics at the 400-500 level, including Mathematics 568 or 571.

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 3[rd] Edition, (chapter 5)

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

Continued.

Course Coordinator
U. Gerlach
2007-2008

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
U. Gerlach
2007-2008

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

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 Topics and Texts:

I.   Eigenvalues and eigenvectors:
      <u>Linear Algebra and its Applications</u>, Strang, 3rd edition, (Ch. 5, 6, and Appendix A)

II.   Infinite-dimensional vector spaces:
      <u>Linear Mathematics in Infinite Dimensions</u>, U. Gerlach, (Ch. 1 and 3)
      <u>Fourier Series and Boundary Value Problems</u>, Churchill and Brown, (Ch. 3)
      <u>Mathematical Methods in Physics and Engineering</u>, Dettman, (Ch. 2)
      Website: http://www.math.ohio-state.edu/~gerlach/math

Continued.

Course Coordinator
U. Gerlach
2007-2008

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)

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

Continued.

<u>Topics List</u>

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)

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 the rate of return of an investment.
7. Term structure of interest rates.
8. Cashflow duration and immunization.

Course Coordinator
C. Ban
2007-2008

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

Prerequisite:

Mathematics 618 (Can be taken concurrently), and Mathematics 530 or Statistics 420 or equivalent;

Catalog Description:

630: Survival distributions and life tables; Life insurance, Annuities

631: Net premiums, Net premium reserves, Multiple life functions.

632: Multiple decrement models, surplus topics, financial accounting topics

Purpose of Courses:

This sequence is designed to introduce students to the mathematical content of the theory of contingencies. The sequence covers the material required for the SOA and CAS exams covering life contingencies. 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.

Course Coordinator
C. R. Evans
2007-2008

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.

Mathematics	651 Au	5 cr. each	Introduction to Real Analysis I
Mathematics	652 Wi		Introduction to Real Analysis II
Mathematics	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,
      (use 98-99, 99-00, and 00-01)
      651: Chapter 1, additional material
      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.]

Continued.

Course Coordinator
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2007-2008

Possible Texts – cont.:

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.

Course Coordinator
P. Nevai
2007-2008

Mathematics	655 Au	4 cr. Each	Elementary Topology I
Mathematics	656 Wi		Elementary Topology II
Mathematics	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, e.g. 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

Continued.

Course Coordinator
Z. Fiedorowicz
2007-2008

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:

Metric and topological spaces and continuity
Connectedness and path-connectedness
Compactness, Tychonoff's Theorem
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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Course Coordinator
Z. Fiedorowicz
2007-2008

| Mathematics 665 (Wi) | 4 cr. | Modern Mathematical Methods |
| Mathematics 666 (Sp) | | 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

Continued.

Course Coordinator
U. Gerlach
2007-2008

Topics List:

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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Course Coordinator
U. Gerlach
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Mathematics	670 Au	5 cr. each	Algebra I
Mathematics	671 Wi		Algebra II
Mathematics	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 aim is 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.

Continued.

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Course Coordinator
R. Solomon
2007-2008

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)

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

Continued.

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U. Gerlach
2007-2008

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

Course Coordinator
U. Gerlach
2007-2008