

Department of Mathematics

The Ohio State University

2010-2011 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
108	Number and Algebraic Structures for Middle School Teachers
109	Geometry and Measurement for Middle School Teachers
110	Algebraic Thinking and Probability for Middle School Teachers
111	Concepts of Calculus for Middle School 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
151.01	Calculus and Analytic Geometry
152.01	Calculus and Analytic Geometry
153.01	Calculus and Analytic Geometry
151.02	Calculus and Analytic Geometry
152.02	Calculus and Analytic Geometry
153.02	Calculus and Analytic Geometry
254.02	Calculus and Analytic Geometry
151.03	Calculus for Biology and Medicine
152.03	Calculus for Biology and Medicine
161.01	Accelerated Calculus with Analytic Geometry
162.01	Accelerated Calculus with Analytic Geometry
263.01	Accelerated Calculus with Analytic Geometry
161.01H	Accelerated Calculus with Analytic Geometry
162.01H	Accelerated Calculus with Analytic Geometry
263.01H	Accelerated Calculus with Analytic Geometry
161.02	Accelerated Calculus with Analytic Geometry I

Course Number	Course Title
162.02	Accelerated Calculus with Analytic Geometry II
263.02	Accelerated Calculus with Analytic Geometry III
187.01H	Advanced Problem Solving
487H	Advanced Problem Solving
190H	Elementary Analysis I
191H	Elementary Analysis II
264H	Elementary Analysis III
212	History of Mathematics for Middle School Teachers
254.01	Calculus and Analytic Geometry IV
255	Differential Equations and Their Applications
345	Foundations of Higher Mathematics
366	Discrete Mathematical Structures I
415.01	Ordinary and Partial Differential Equations
415.02	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
531H	Rigorous 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
556	Differential Equations I
557	Differential Equations II
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

Course Number	Course Title
577H	Number Theory Through History II
578	Discrete Mathematical Models
580	Algebra I
581	Algebra II
582	Algebra III
588	Practicum in Actuarial Science
590H	Algebraic Structures I
591H	Algebraic Structures II
592H	Algebraic Structures III
601	Mathematical Principles in Science I
602	Mathematical Principles in Science II
603.02	Mathematical Principles in Science III, B
615	Applied Differential Equations I
616	Applied Differential Equations II
617	Applied Differential Equations 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 I
670	Algebra I
671	Algebra II
672	Algebra III
701	Mathematical Principles in Science III: Calculus of Variations & Tensor Calculus

Mathematics 50
Au, Wi, Sp, Su

5 credits

Pre-College Mathematics I

Prerequisite:

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

Catalog Description:

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

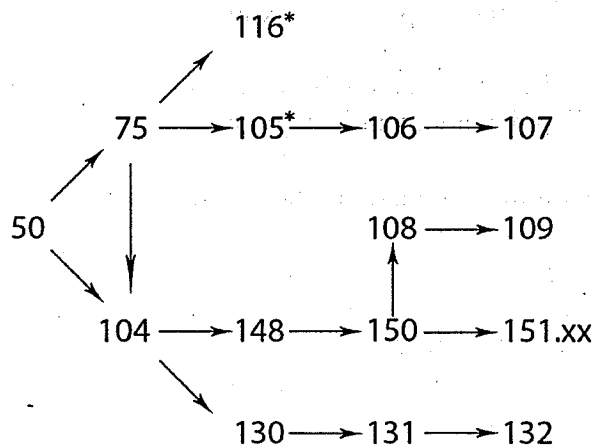
Purpose of Course:

Mathematics 50 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 75 or 104. Math conditions are removed by completion of 50 and 75 or 50 and 104.

Follow-up Course:

Math 75 or Math 104

Sequencing Chart:



*104 may serve as a prerequisite,
but not recommended.

Text:

Beginning Algebra With Applications, 7th edition, by Aufmann/Barker/Lockwood, Cengage.
Chapters 1 – 8 (omit Chapter 6 and Sections 5.5, 5.6 and 8.5).

Continued:

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THE OHIO STATE UNIVERSITY
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**Math 50
Course Coordinator: C. Roman
2010-2011**

Topics List:

1. Review of arithmetic, fractions, mixed numbers, decimals, exponential notation:
 - The number line - rational and real numbers.
 - Properties of numbers:
 - prime factors
 - divisibility
 - order of operations
 - least common multiple
 - greatest common factor
 - distributive property
 - division algorithm
 - Arithmetic of signed numbers, properties of real numbers
 - Exponents - integral exponents and rational exponents (numerically)
 - laws of exponents
 - simplification of exponential expressions
 - Note: Many of these topics are introduced at later points in the text, as needed for the corresponding development in algebra.
2. Problem solving with linear equations and inequalities:
 - Solving linear equations, linear inequalities in one variable
 - Applied problems and formulas:
 - cost, proportion, percent compound interest
 - inequalities
 - geometric figures
3. Introduction to coordinate systems, ordered pairs, graphs of linear equations, slope, intercepts, slope-intercept form, horizontal and vertical lines.
4. Polynomial arithmetic: Addition/subtraction, multiplication, division with remainder, factoring. Special products. Scientific notation.
5. Basic geometric figures; perimeters and areas: Triangles, circles, polygons.

Prerequisite:

Mathematics 50, or Course Code S on Math Placement Test. Not open to students with credit for any math course except 50.

Catalog Description:

Factoring, rational expressions and equations, graphs, systems of linear equations and inequalities, problem solving, roots and radicals, quadratic equations, complex numbers.

Purpose of Course:

To meet the needs of students entering the University with Course Code S on Math Placement Test, or with credit for 50. In addition, students placing at Course Code R and who need Math 130, must take 104 prior to enrolling in 130. Completion of Math 75 is required for entry into numerous degree granting colleges; however, credit for Math 75 will not count toward graduation in any degree granting program. It is designed for students continuing in Math 105 or 116.

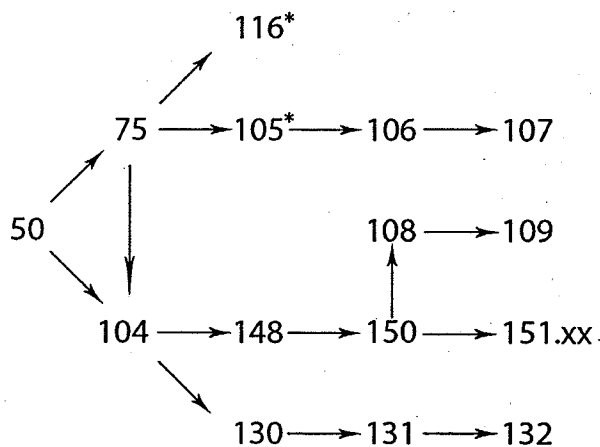
Follow-up Courses:

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:



*104 may serve as a prerequisite, but not recommended.

Text:

Beginning Algebra With Applications, 7th Edition, Aufmann/Barker/Lockwood, Cengage
ISBN 9780618969913

Continued:

Math 75

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Math 75

Course Coordinator: B. McEnnis

2010-2011

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Topics List:

- 5.3–5.4 Graphing**
Slopes of straight lines
Slope-intercept form
Point-slope form
- 6.1–6.4 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
- 8.1–8.5 Factoring polynomials**
Greatest common factor and factoring by grouping
Factoring trinomials
Factoring binomials
Solving quadratic equations by factoring
- 9.1–9.7 Rational expressions**
Simplifying rational expressions
Multiplying and dividing rational expressions
Least common denominator
Adding and subtracting rational expressions
Complex fractions
Solving equations containing rational expressions
Ratio and proportion
Rational equations and problem solving
- 10.1–10.4 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
- 11.1–11.4 Quadratic equations**
Solving quadratic equations by the square root method
Solving quadratic equations by completing the square
Solving quadratic equations by the quadratic formula
Complex numbers

Mathematics 104
Au, Wi, Sp, Su

5 credits

Basic College Mathematics

Prerequisite:

Mathematics 50, or 75, or Course Code R on Math Placement Test. Not open to students with credit for 130 or 148 or 150 or 151.xx.

Catalog Description:

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

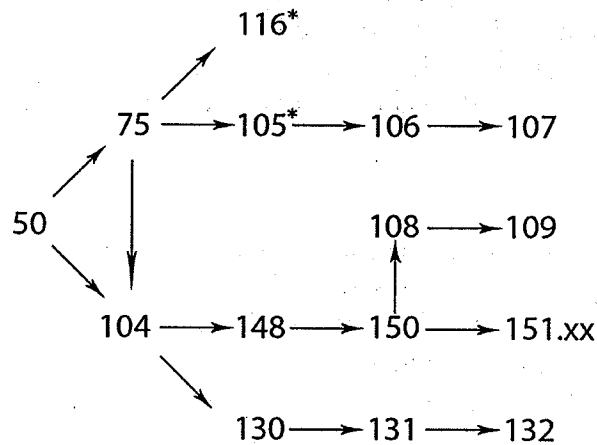
Purpose of Course:

To meet the needs of students entering the University with Course Code R or with credit for Math 50 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:



*104 may serve as a prerequisite,
but not recommended.

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Text:

Beginning and Intermediate Algebra for The Ohio State University, 2nd edition, by Hall/Mercer, McGraw-Hill, ISBN 0077379055.

Continued:

Math 104
Course Coordinator: R. Aboughazi
2010-2011

Topics List:

<u>Section</u>	<u>Topics</u>
3.1/3.2	Slope of a Line and Linear Equations
3.3	Solving Systems of Linear Equations in Two Variables Graphically and Numerically
3.4/3.5	Solving Systems of Linear Equations using the Substitution and Addition Methods
3.6	More Applications of Linear Systems
4.1/4.2	Solving Linear Inequalities
4.3	Compound Inequalities
4.4	Absolute Value Equations and Inequalities
6.1	An Introduction to Factoring polynomials

Review and Exam 1

6.2/6.3	Factoring Trinomials
6.4/6.5	Special Forms and a General Strategy for Factoring Polynomials
6.6	Solving Equations by Factoring
7.1	Functions and Representation of Functions
7.2/7.3	Absolute Value and Quadratic Functions
7.4	Using the Quadratic Formula to Find Real Solutions
7.5/7.6	Application of Quadratic Equations
7.7	Complex Numbers and Quadratic Equations with Complex Solutions

Review and Exam 2

8.1	Graphs of Rational Functions and Reducing Rational Expressions
8.2/8.3	Operations on Rational Expressions
8.4	Combining Operations and Simplifying Complex Rational Expressions
8.5	Equations Containing Rational Expressions
9.1	Evaluating Radical Expressions and Graphing Square Root and Cube Root Functions
9.2	Adding and Subtracting Radical Expressions
9.3	Multiplying and Dividing Radical Expressions
9.4	Equations Containing Radical Expressions
9.5	Rational Exponents and Radicals
Appendix Horizontal and Vertical Translations of the Graphs of Functions	

Review and Exam 3

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Mathematics 105
Su, Au, Wi

5 credits

Fundamental Mathematics
Concepts for Teachers I

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

Prerequisite:

Mathematics 75 or 104, or Course Code L, M, N or R on Math Placement Test.

Catalog Description:

Development of basic ideas of arithmetic as appropriate for early elementary school 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. Appropriate **only** for those preparing to become early childhood educators and for those preparing to teach subjects other than math in middle school.

Follow-up Course:

Math 106

Text:

Mathematics for Elementary Teachers with Activity Manual, 3rd Edition, (2010) by Sybilla Beckmann, Pearson, ISBN for the package is 0321654277

Topics List:

- I. Numbers and the Decimal System
- II. Fractions
- III. Addition and Subtraction
- IV. Multiplication
- V. Multiplication of Fractions, Decimals, and Negative Numbers
- VI. Division
- VII. Combining Multiplication and Division: Proportional Reasoning

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Math 105
Course Coordinator: B. McNeal
2010-2011

Mathematics 106
Wi, Sp

5 credits

Fundamental Mathematics
Concepts for Teachers II

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

Prerequisite:

Mathematics 105 or written permission of the department.

Catalog Description:

Continuation of Math 105. Development of basic ideas of geometry as appropriate for early elementary school 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 106 introduces length, area, volume, angle, Euclidean geometry, congruent and similar triangles, symmetry and rigid motion, and knowledge of general spatial skills. *Appropriate for those preparing to become early childhood educators and for those preparing to teach subjects other than math in middle school.*

Follow-up Course:

Math 107

Text:

Mathematics for Elementary Teachers, and Mathematics for Elementary Teachers: Activities Manual, 2nd Edition, (2008) by Sybilla Beckmann, Addison-Wesley, ISBN for the package is 0321447174

Topics List:

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

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Math 106
Course Coordinator: B. McNeal
2010-2011

Mathematics 107
Au, Sp

5 credits

Topics in Mathematics
For Elementary Teachers

**Currently taught in workshop format.*

Prerequisite:

Mathematics 105 and 106.

Catalog Description:

Further topics in mathematics selected by the instructors to broaden the mathematical perspectives of early 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 number theory, combinatorics, probability, early algebra, functions, graphs, sequences and series, and general mathematical skills. Appropriate **only** for those preparing to become early childhood educators and for those preparing to teach subjects other than math in middle school.

Text:

Mathematics for Elementary Teachers with Activity Manual, 3rd Edition, (2010) by Sybilla Beckmann, Pearson, ISBN for the package is 0321654277

and supplemental materials provided in class.

Topics List:

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

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Math 107
Course Coordinator: B. McNeal
2010-2011

Mathematics 108
Au

5 credits

**Number and Algebraic
Structures for Middle
School Teachers**

Prerequisite:

Mathematics 150 or higher, or Math Placement Level L. Note: Open only to middle childhood majors.

Catalog Description:

Concepts of arithmetic, including number systems, binary operations, combinatorial counting, and number theory.

Purpose of Course:

The purpose of the course is to prepare teachers of middle school students. In particular, it intends to deepen and extend the prospective teachers' content knowledge of the mathematics they will teach as well as their ability to reason with and communicate that knowledge.

Follow-up Course:

Mathematics 109

Text:

Course Notes

Topics List:

1. Number Systems
2. Addition and Subtraction
3. Multiplication and Division
4. Exponents and Roots/Logs
5. Combinatorial Counting
6. Number Theory
7. Divisibility
8. Algebraic Structures
9. Complex Numbers

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Math 108
Course Coordinator: H. Clemens
2010-2011

Mathematics 109
Wi

5 credits

**Geometry
and Measurement for
Middle School Teachers**

Prerequisite:

Mathematics 108. Note: Open only to middle childhood majors.

Catalog Description:

Geometrical concepts of definitions, postulates, congruence, similarity, coordinate geometry, transformations, and non-Euclidean geometry. Measurement concepts of units, conversion, irregular shapes, Pythagorean Theorem, and Cavalieri's Principle.

Purpose of Course:

The purpose of the course is to prepare teachers of middle school students. In particular, it intends to deepen and extend the prospective teachers' content knowledge of the mathematics they will teach as well as their ability to reason with and communicate that knowledge.

Follow-up Courses:

Statistics 145 and Mathematics 110

Text:

Course Notes.

Topics List:

1. Definitions and Euclidean postulates
2. Measurement (also teaching measurement in middle school))
3. Congruence (also introducing congruence in middle school))
4. Similarity (informal approach and theoretical underpinnings)
5. Coordinate geometry
6. Transformations of the plane
7. Transformations in Euclidean 2 and 3 dimensional space
8. Parallel postulate, introduction to non-Euclidean geometry

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Math 109
Course Coordinator: H. Clemens
2010-2011

Mathematics 110
Au

5 credits

**Algebraic Thinking and
Probability for Middle
School Teachers**

Prerequisite:

Mathematics 108, 109, Stat 145.

Note: *Open only to middle childhood majors.*

Catalog Description:

Roles and representations of variables and formulas, functions and other relations, and methods of solving equations. Randomness, expected value, simulations, and binomial and geometric probabilities.

Purpose of Course:

The purpose of the course is to prepare teachers of middle school students. In particular, it intends to deepen and extend the prospective teachers' content knowledge of the mathematics they will teach as well as their ability to reason with and communicate that knowledge.

Follow-up Courses:

Mathematics 111, 212

Text:

- 1) Course Notes
- 2) Mathematics Modeling for Today's Mathematics Classroom. Dossey, John, et al. (2002). Brooks/Cole.

Topics List:

- 1) Functions and their representations
- 2) Mathematical modeling
- 3) Difference equations, linear programming
- 4) Counting, permutations and combinations
- 5) Regression, arithmetic sequences, geometric sequences and series
- 6) Probability
- 7) Randomness, Monte Carlo methods
- 8) Data and curve-fitting

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Math 110
Course Coordinator: H. Clemens
2010-2011

Mathematics 111
Wi

5 credits

**Concepts of Calculus for
Middle School Teachers**

Prerequisite:

Mathematics 108, 109, 110.

Note: Open only to middle childhood majors.

Catalog Description:

Language, representations, informal and formal calculations, and applications of instantaneous rates and accumulation through derivatives and integrals.

Purpose of Course:

The purpose of the course is to prepare teachers of middle school students. In particular, it intends to deepen and extend the prospective teachers' content knowledge of the mathematics they will teach as well as their ability to reason with and communicate that knowledge.

Follow-up Courses:

None currently. This course fulfills the calculus requirement for middle school mathematics teachers with a Mathematics Concentration. It will be followed up by Mathematics 212.

Text:

Under Consideration

Supplementary Text: Course Notes

Topics List:

1. Language and notation of rates and area
2. Picturing rates and area
3. Informally measuring rate
4. Precisely measuring rate
5. Informally measuring area
6. Precisely measuring area
7. Applications of differential calculus
8. Applications of integral calculus

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Math 111
Course Coordinator: H. Clemens
2010-2011

Mathematics 212
Sp

5 credits

History of Mathematics
for Middle School Teachers

Prerequisite:

Math 110 and 111. Open only to middle childhood majors.

Catalog Description:

Historical development of concepts appropriate to middle childhood mathematics. A capstone course to bring together topics discussed in 108, 109, 110, 111 and Statistics 145.

Purpose of Course:

The general goal of this course is to prepare you to become teachers of middle school students. Knowing the mathematics for yourself is not the same as knowing the math for teaching.

Text:

Math through the Ages: A Gentle History for Teachers and Others (Expanded Edition), by Berlinghoff, W. P. & Gouvea, F.Q. (2004). Oxtan House Publishers, Mathematical Assn. of America.

Topics List:

- 1 History of whole numbers and fractions
- 2 The Story of π
- 3 Origins of linear thinking: Solving First Degree Equations
- 4 Greek Mathematics
 - The Pythagorean Theorem
 - Euclid's Plane Geometry
 - The Platonic Solids
- 5 Mathematics in India
 - The Story of Zero
 - Negative Numbers
 - Sine and Cosine
- 6 Arabic mathematics
 - Quadratic Equations
 - Beginnings of algebra
- 7 Medieval Europe
 - Reading & Writing Arithmetic: Where the Symbols Came From
 - Solving Cubic Equations
- 8 The 15th and 16th Centuries
 - Projective Geometry
 - Algebra Comes of Age
- 9 Coordinate Geometry
- 10 Non-Euclidean Geometries
- 11 Calculus and Applied Mathematics
- 12 Rigor and Professionalism
- 13 Abstraction, Computers and New Applications

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Math 212
Course Coordinator: H. Clemens
2010-2011

Mathematics 116
Au*, Wi, Sp, Su

5 credits

Excursions in Mathematics

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

Prerequisite:

Mathematics 75 or 104 or course code R on Math Placement Test.

Catalog Description:

Critical thinking and 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, 7th edition, by Tannenbaum/Arnold, Prentice-Hall, ISBN 0321568036

Continued.

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**Math 116
Course Coordinator: G. Kennedy
2010-2011**

Topics List chosen from the following:

Graph theory

Graphs, Euler circuits, Hamilton circuits, the Traveling Salesman Problem, TSP algorithms, spanning trees, Kruskal's algorithm

Voting & apportionment

Preference ballots, methods of determining the winner of an election, apportionment and its paradoxes, a history of U.S. Congressional apportionment, the methods of Jefferson, Adams, and Webster

Patterns & growth

Sequences defined by recursion, the Fibonacci sequence, the golden ratio, arithmetic and geometric sequences, models of population growth: linear, exponential, and logistic

Symmetry

Rigid motions, symmetry, rosettes & friezes, rudiments of group theory

Counting & probability

Counting principles, permutations and combinations, multiplication rule, randomness, sample spaces & probability spaces

Fractals

Recursive definitions of fractals, standard examples (Koch snowflake, Sierpinski gasket et al), self-similarity, notions of fractional dimension

Linear programming

Mixture problems, examples in low dimension, the cornerpoint principle, algorithms

(Note that this topics list is too long for any single course. Each instructor will make a selection from it.)

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Mathematics 117
Au, Wi, Sp

5 cr.

Survey of Calculus

Prerequisite:

Math 150, Course Code Level L, or Permission from 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 for whom the course is a requirement. The intent of the course is to introduce these students to the derivative and definite integral of single-variable functions, using rate of change and slope as a conceptual model for the derivative, and net change and area as a conceptual model for the definite integral. Emphasis will be placed on using these concepts to model and solve problems in the physical world. Algebraic, graphical, and tabular representations of these ideas will be used.

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 (4th Edition, 2010). Published by Thomson Brooks/Cole. ISBN: 0495559725

Calculator:

A graphing calculator is required for this course. Most instructors will be familiar with the Texas Instrument TI-83, 83Plus, or 84. NOTE: Calculators with a Computer Algebra System such as the TI-89 or TI-92 will not be permitted in the course.

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Math 117
Course Coordinator: V. Ferdinand
2010-2011

Tentative Topics List (4th Edition):

Chapter 2: Limits and Derivatives

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

Chapter 3: Differentiation Rules

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

Chapter 4: Applications of Differentiation

- 4.2: Maximum and Minimum Values
- 4.3: Derivatives and the Shapes of Curves
- 4.6: Optimization Problems
- 4.8: Antiderivatives

Chapter 5: Integrals

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

Chapter 6: Applications of Integration

- 6.1: More about Areas
- 6.2: Volumes (by slicing, of solids of revolution)
- 6.4: Arc Length (If time permits)
- 6.5: Average Value of a Function (If time permits)
- 6.6: Applications in Physics and Engineering (e.g., Moments and Center of Mass, Hydrostatic Force)

If Time: Surface Area of Solids of Revolution

Brief Overview of Multivariable Calculus (If time permits)

Partial Derivatives, Tangent/Normal Planes, Optimization
Multiple Integrals, Volume, Center of Mass

Mathematics 130
Au, Wi, Sp, Su

4 cr.

Math Analysis for Business I

Prerequisite:

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

Catalog Description:

Equations, inequalities, functions, graphing, systems of equations, 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, 3rd OSU custom edition, by Barnett, Pearson, ISBN 055835176X (textbook ISBN 0558391028, MyMathLab Access Card ISBN 0321199901)

Topics List:

Sections	Topics
1.1, 1.2	Linear Equations and Inequalities; Graphs and Lines
2.1, 2.2	Functions, Graphs and Transformations
2.3	Quadratic Functions
4.1, 3.5(H)	Systems of Equations (Linear and Nonlinear)
2.4, 2.5	Exponential and Logarithmic Functions
3.1, 3.2	Simple, Compound and Continuous Compound Interest
3.3	Future Value of an Annuity; Sinking Fund
5.2(H)	Present Value
3.4	Present Value of an Annuity; Amortization

**DEPARTMENT OF MATHEMATICS
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Math 130
Course Coordinator: T. Niemeyer
2010-2011

Mathematics 131

4 cr.

Mathematical Analysis for Business II

Au, Wi, Sp, Su

Prerequisite:

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

Catalog Description:

Differential calculus, limits, definition of derivative, calculation of derivatives, curve sketching, applications.

Purpose of Course:

Math 131 is designed to introduce students in the College of Business to limits and derivatives. The course is problem oriented with an emphasis on business applications.

Follow-up Course:

Math 132.

Text:

Introductory Mathematical Analysis, 3rd OSU custom edition, by Barnett, Pearson, ISBN 978-0-558-35177-9

Technology:

All students are required to have a graphing calculator 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:

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Math 131
Course Coordinator: B. Husen
2010-2011

Topics List:

Sections	Topics
10.1	Limits
10.2	Continuity
10.3	Infinite Limits and Limits at Infinity
10.4	The Derivative
10.5	Basic Differentiation Properties
10.7	Marginal Analysis in Business and Economics
11.1	The Constant e and Continuous Compound Interest
11.2	Derivatives of the Exponential and Logarithmic Functions
11.3	Derivatives of Products and Quotients
11.4	The Chain Rule
11.5	Implicit Differentiation
12.1	First Derivative and Graphs
12.2	Second Derivative and Graphs
12.4	Curve-Sketching Techniques
12.5	Absolute Maxima and Minima
12.6	Optimization

Mathematics 132
Au, Wi, Sp, Su

5 cr.

Mathematical Analysis for Business III

Prerequisite:

Mathematics 131 or 151.xx.

Catalog Description:

Integral calculus, indefinite integrals, area and definite integrals, functions of several variables, partial derivatives, maxima and minima, systems of linear equations, Gauss-Jordan elimination, matrices and matrix equations.

Purpose of Course:

Math 132 is designed to introduce students in the College of Business to integrals, matrices and its applications. The course is problem oriented with emphasis on business applications.

Follow-up Course:

Statistics 133 for most students in Business.

Math 150 for those students switching majors and needing the main-line calculus sequence.

CAUTION: Students completing Math 132 may not enroll in Math 153.

Text:

Introduction to Mathematical Analysis, 3rd OSU custom edition, by Barnett, Zieler & Byleen,
ISBN 978-0-558-35177-9

Continued.

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Math 132
Course Coordinator: S. Wong
2010-2011

Topics List:

<u>Topics</u>	<u>Sections</u>
10.6	Differentials
13.1	Antiderivatives and Indefinite Integrals
13.2	Integration by Substitution
13.3	Differential Equations: Growth and Decay
13.4	The Definite Integral
13.5	The Fundamental Theorem of Calculus
14.1	Area between Curves
14.2	Applications in Business and Economics
15.1	Functions of Several Variables
15.2	Partial Derivatives
17.3	Applications of Partial Derivatives
15.3	Maxima and Minima
15.4	Maxima and Minima using Lagrange Multipliers
4.1	Systems of Linear Equations in Two Variables
4.2	Systems of Linear Equations and Augmented Matrices
4.3	Gauss-Jordan Elimination
4.4	Matrices: Basic Operations
4.5	Inverse of a Square Matrix
4.6	Matrix Equations and Systems of Linear Equations

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Mathematics 148
Au, Wi, Sp, Su

4 cr.

**Algebra and Trigonometry
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 at the same time reinforcing the algebra and trigonometry skills needed to proceed with more advanced mathematics.

Follow-up Course:

Math 150 for those students needing to take Math 151.

Text:

Contemporary College Algebra and Trigonometry. Math 148. The Ohio State University. 2010-2011 Edition, Pearson, ISBN 0558844405.

Technology:

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

Continued:

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Math 148
Course Coordinator: E. Conrad
2010-2011

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
2.2	First Degree Equations and Applications
2.3	Quadratic Equations and Applications
2.4	Maximum and Minimum Applications
3.1	Functions
3.2	The Art of Estimating
4.1	Exponential Functions
4.2	Applications of Exponential Functions
4.3	Common and Natural Logarithm Functions
4.4	Properties of Logarithms
5.5	<u>Algebraic Solutions of Exponential and Logarithmic Equations</u>
5.1/5.2	Variation & Arc Length and Area of a Circular Sector
5.3	Geometry: Similar Triangles
6.1	Right Triangle Trigonometry and Applications
6.2	Trigonometric Functions of any Angle
6.3	The Law of Sines
6.4	The Law of Sines, the Ambiguous Case
6.5	Law of Cosines

Mathematics 150
Au, Wi, Sp, Su

5 cr.

Elementary Functions

Prerequisite:

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

Catalog Description:

Inverse functions, rational, 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.xx or Math 117 or Math 108.

Text:

Precalculus: Mathematics for Calculus, 5th OSU Custom Edition, by Stewart/Redlin/Watson, Cengage, ISBN 1111207801.

Alternate Textbook: Precalculus: Mathematics for Calculus, 5th edition, by Stewart/Redlin/Watson, Thomson, ISBN 0534492770.

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:

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Math 150
Course Coordinator: N. Lakos
2010-2011

Topics List:

Sections	Topics
2.1	What is a Function?
2.2	Graphs of Functions
2.3	Increasing and Decreasing Functions; Average Rate of Change
2.4	Transformations of Functions
2.5	Quadratic Functions; Maxima and Minima
2.6	Modeling with Functions
2.7	Combining Functions
2.8	One-to-One Functions and Their Inverses
3.1	Polynomial Functions and Their Graphs
3.4	Complex Numbers
3.5	Complex Zeros and the Fundamental Theorem of Algebra
3.6	Rational Functions
3.7	Polynomial and Rational Inequalities
4.1	Exponential Functions
4.2	Logarithmic Functions
4.3	Laws of Logarithms
4.4	Exponential and Logarithmic Equations
4.5	Modeling with Exponential and Logarithmic Functions
5.1	Angle Measure
5.2	Trigonometry of Right Triangles
6.1	The Unit Circle
6.2	Trigonometric Functions of Real Numbers
6.3	Trigonometric Graphs
6.4	More Trigonometric Graphs
7.1	Trigonometric Identities
7.2	Addition and Subtraction Formulas
7.3	Double-Angle, Half-Angle, and Sum-Product Formulas
7.4	Inverse Trigonometric Functions
7.5	Trigonometric Equations
8.3	Polar Form of Complex Numbers; DeMoivre's Theorem

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Mathematics 151.01

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, rules of differentiation, differentiation of the trig, log, and exp functions, related rates, linear approximations and differentials, extrema, curve sketching, Mean Value theorem, optimization problems, L'Hôpital's rule, Newton's method.

Purpose of Course:

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

Follow-up Course:

Math 152.01

Text:

Calculus: Early Transcendentals, Volume 1, 6th OSU custom edition, by Stewart (Cengage), ISBN 978-1-4-2406455-7.

Alternate Text: Calculus: Early Transcendentals, 6th edition, by Stewart (Thomson Brooks/Cole), ISBN 0495011665.

Supplementary Text: Just-In-Time: Algebra and Trigonometry for Students of Calculus, 3rd edition, by G. Mueller, R.I. Brent (Addison Wesley), ISBN 0321269438

Continued.

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Math 151.01
Course Coordinator: C. Ogle
2010-2011

Topics List & Sample Syllabus:

<u>Sections</u>	<u>Topics</u>
1.5 Exponential Functions	3.6 Derivatives of Logarithmic Functions
1.6 Inverse Functions and Logarithms	3.7 Rates of Change in the Natural and Social Sciences
2.1 The Tangent and Velocity Problems	3.8 Exponential Growth and Decay
2.2 The Limit of a Function	3.9 Related Rates
2.3 Calculating Limits Using the Limit Laws	3.10 Linear Approximations and Differentials
2.5 Continuity	4.1 Maximum and Minimum Values
2.6 Limits at Infinity; Horizontal Asymptotes	4.2 The Mean Value Theorem
2.7 Derivatives and Rates of Change	4.3 How Derivatives Affect the Shape of the Graph
2.8 The Derivative as a Function	4.5 Summary of Curve Sketching
3.1 Derivatives of Polynomials and Exponential Functions	4.7 Optimization Problems
3.2 The Product and Quotient Rules	4.9 Antiderivatives
3.3 Derivatives of Trigonometric Functions	4.6 Graphing with Calculus and Calculators
3.4 The Chain Rule	4.4 Indeterminate forms and L'Hopital's Rule
3.5 Implicit Differentiation	4.8 Newton's method

Mathematics 151.02 Au **5 credits Each** **Calculus and Analytic Geometry**
Mathematics 152.02 Wi
Mathematics 153.02 Sp
Mathematics 254.02 Au

Prerequisites:

The prerequisites are the same as those for 151.01, 152.01, 153.01, 254.01; e.g. for 151.02 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 151.01, 152.01, 153.01, 254.01.

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 151.02 students should be encouraged to take Math 152.02, 153.02 and 254.02. Students should be able to switch between the ".02" sequence and the traditional ".01" calculus sequence.

Text:

Calculus: Single & Multivariable, 5th Edition, by Hughes-Hallett/Gleason, et al., Wiley, ISBN-10: 0470089148, ISBN-13: 978-0470089149

Topics List:

151.02:

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	Global Optimization
2.4	Interpretations Of The Derivative	4.3	Families of Functions
2.5	The Second Derivative	4.4	Optimization, Geometry and Modeling
2.6	Differentiability	4.5	Applications to Marginality
4.6	Rates & Related Rates		

Continued:

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Math 151.02, 152.02, 153.02, 254.02
 Course Coordinator: I. Leary
 2010-2011

152.02:

Section	Title	Section	Title
4.7	L'Hopital's Rule, Growth and Dominance	7.2	Integration By Parts
5.1	How Do We Measure Distance Traveled?	7.3	Tables Of Integrals
5.2	The Definite Integral	7.4	Algebraic Identities & Trigonometric Substitutions
5.3	The Fundamental Theorem & Interpretations	7.7	Improper Integrals
5.4	Theorems About Definite Integrals	7.8	Comparison Of Improper Integrals
6.1	Antiderivatives Graphically & Numerically	8.1	Areas & Volumes
6.2	Constructing Antiderivatives Analytically	8.2	Applications To Geometry
6.3	Differential Equations	8.4	Density & Center Of Mass
6.4	Second Fundamental Theorem Of Calculus	8.5	Applications to Physics
6.5	The Equations Of Motion		
7.1	Integration By Substitution		

153.02:

Section	Title	Section	Title
9.1	Sequences	12.2	Graphs Of Functions Of Two Variables
9.2	Geometric Series	12.3	Contour Diagrams
9.3	Convergence of Series	12.4	Linear Functions
9.4	Tests For Convergence	12.5	Functions Of Three Variables
9.5	Power Series & Interval Of Convergence	12.6	Limits & Continuity
10.1	Taylor Polynomials	13.1	Displacement Vectors
10.2	Taylor Series	13.2	Vectors In General
10.3	Finding & Using Taylor Series	13.3	The Dot Product
10.4	The Error In Taylor Polynomial Approximations	13.4	The Cross Product
12.1	Functions Of Two Variables	17.1	Parameterized Curves
		17.2	Motion, Velocity, & Acceleration

254.02:

Section	Title	Section	Title
14.1	The Partial Derivative	17.3	Vector Fields
14.2	Computing Partial Derivatives Algebraically	18.1	The Idea Of A Line Integral
14.3	Local Linearity & The Differential	18.2	Computing Line Integrals Over Parameterized Curves
14.4	Gradients & Directional Derivatives In The Plane	18.3	Gradient Fields & Path-Independent Fields
14.5	Gradients & Directional Derivatives In Space	18.4	Path-Dependent Vector Fields & Green's Theorem
14.6	The Chain Rule	19.1	The Idea Of A Flux Integral
16.1	The Definite Integral Of A Function Of Two Variables	19.2	Flux Integrals For Graphs, Cylinders, & Spheres
16.2	Iterated Integrals	20.1	The Divergence Of A Vector Field
16.3	Triple Integrals	20.2	The Divergence Theorem
16.4	Double Integrals In Polar Coordinates	20.3	The Curl Of A Vector Field
16.5	Integrals In Cylindrical & Spherical Coordinates	20.4	Stokes' Theorem

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Math 151.02, 152.02, 153.02, 254.02
 Course Coordinator: I. Leary
 2010-2011

Mathematics 151.03
Au

5 credits

Calculus for Biology and Medicine

Prerequisite:

Mathematics 150 (with grade C- or above) 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 calculus, to model and analyze phenomena in the life sciences

Follow-up Course:

Math 152.03

Text:

Calculus for Biology and Medicine, 2nd Edition, by Claudia Neuhauser, Pearson, ISBN 0130455164

Topics List & Sample Syllabus:

Chapter 1 (1-2 lectures)
1.2: Elementary functions
1.3: Graphing

Chapter 2: (1-2 lectures)
2.1.1: Exponential growth and decay
2.2.2: Sequences

Chapter 3: (4-5 lectures)
3.1: Limits
3.2: Continuity
3.3: Limits at infinity
3.4: The Sandwich Theorem and some trigonometric limits
3.5: Properties of continuous functions

Continued.

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Math 151.03
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Chapter 4 (7-8 lectures)

- 4.1: Formal definition of the derivatives
- 4.2: The power rule, basic rules of differentiation, and derivatives of polynomials
- 4.3: The product and quotient rules, derivatives of rational and power functions
- 4.4: The chain rule, related rates, and higher derivatives
- 4.5: Derivatives of trigonometric functions
- 4.6: Derivatives of exponential functions
- 4.7: Derivatives of inverse and logarithmic functions
- 4.8: Approximation and local linearity

Chapter 5 (8-9 lectures, team projects will be assigned during this period)

- 5.1: Extrema and the Mean Value Theorem
- 5.2: Monotonicity and concavity
- 5.3: Extrema, inflection points, and graphing
- 5.4: Optimization
- 5.8: Anti-derivatives (optional)

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**Math 151.03
Course Coordinator: A. Nance
2010-2011**

Mathematics 152.01
Au, Wi, Sp, Su

5 cr.

Calculus and Analytic Geometry

Prerequisite:

Mathematics 151.xx with grade of C- or better.

Catalog Description:

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

Purpose of Course:

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

Follow-up Course:

Math 153.01

Text:

Calculus: Early Transcendentals, Volume 1, 6th OSU custom edition, by Stewart, Cengage, ISBN-13: 978-1-4240-6455-7 or ISBN-10: 1-4240-6455-4.

Alternate Text: Calculus: Early Transcendentals, 6th edition, by Stewart, Thomson, ISBN 0534393217.

Continued:

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Math 152.01
Course Coordinator: Z. Fiedorowicz
2010-2011

Topics List & Sample Syllabus

Sections	Topics
4.4	Indeterminate Forms and L'Hospital's Rule
5.1	Areas and Distances
5.2	The Definite Integral
5.3	The Fundamental Theorem of Calculus
5.4	Indefinite Integrals and the Net Change Theorem
5.5	The Substitution Rule
5.6	The Logarithm Defined as an Integral
6.1	Areas between Curves
6.2	Volumes
6.3	Volumes by Cylindrical Shells
6.4	Work
7.1	Integration by Parts
7.2	Trigonometric Integrals
7.3	Trigonometric Substitution
7.4	Integration of Rational Functions by Partial Fractions
7.8	Improper Integrals
8.1	Arc Length
8.2	Area of a Surface of Revolution
9.1	Modeling with Differential Equations
9.3	Separable Equations
9.4	Exponential Growth and Decay

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Math 152.01
Course Coordinator: Z. Fiedorowicz
2010-2011

Prerequisite:

Mathematics 151.03

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 calculus, to model and analyze phenomena in the life sciences

Text:

Calculus for Biology and Medicine, Claudia Neuhauser, Second Edition, Pearson Education, INC

Topics List & Sample Syllabus:

Section	Topic
6.1	The Area Problem, Riemann Integrals
6.2	Fundamental Theorem of Calculus, Antiderivatives and Indefinite Integrals
6.3	Applications of Integration – Areas, Cumulative Change, Average Values, Volume of a Solid, Rectification of Curves
7.1	The Substitution Rule for Indefinite Integrals
7.2	The Substitution Rule for Definite Integrals
7.3	Integration, Rational Function and Partial Fractions
7.4	Improper Integrals – Unbounded Intervals, Unbounded Integrand
7.5	Numerical Integration – Midpoint Rule, Trapezoidal Rule
7.6	Tables of Integrals
7.7	Taylor Approximation, Taylor Polynomials,
8.1	Solving Differential Equations – Pure Time, Autonomous, Allometric Growth

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Math 152.03
Course Coordinator: A. Nance
2010-2011

Mathematics 153.01
Au, Wi, Sp, Su

5 cr.

Calculus and Analytic Geometry

Prerequisite:

Mathematics 152.xx with C- or better or 161 or 161.01H.

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 covering such topics as infinite series, power series, Taylor theorem; planar curves; vectors, curves and surfaces in space.

Follow-up Course:

Math 254

Text:

For Spring 2010 and thereafter:

Calculus: Early Transcendentals, Volume 2, 6th OSU custom edition, by Stewart, Cengage,
ISBN-13: 978-1-4240-6457-1 or ISBN-10: 0-4240-6457-0

Continued:

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Math 153.01
Course Coordinator: K. Koenig
2010-2011

Topics & Sample Syllabus:

<u>Week</u>	<u>Sections</u>	<u>Topics</u>
Week 1	11.1	Sequences
	11.2	Series
	11.3	The integral test and estimates of sums
Week 2	11.4	The comparison tests
	11.5	Alternating series
	11.6	Absolute convergence, and the ratio and root tests
Week 3	11.7	Strategy for testing series
	11.8	Power series
	11.9	Representations of functions as power series
Week 4	11.10	Taylor and Maclaurin series
		Taylor and Maclaurin series (cont.), binomial series
	11.11	Applications of Taylor polynomials
Week 5		<i>Midterm 1</i>
	10.1	Curves defined by parametric equations
	10.2	Calculus with parametric curves
Week 6	10.3	Polar coordinates
	10.4	Area and lengths in polar coordinates
	12.1	Three-dimensional coordinate systems
Week 7	12.2	Vectors
	12.3	The dot product
	12.4	The cross product
Week 8	12.5	Equations of lines and planes
		<i>Midterm 2</i>
	12.6	Cylinders and quadric surfaces
Week 9	15.7,15.8	Cylindrical and spherical coordinates
	13.1	Vector functions and space curves
	13.2	Derivatives and integrals of vector functions
Week 10	13.3	Arc length and curvature
		<i>Review</i>

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Math 153.01
 Course Coordinator: K. Koenig
 2010-2011

Mathematics 161.01 Au
Mathematics 162.01 Wi
Mathematics 263.01 Sp

5 cr. Each

Accelerated Calculus
with Analytic Geometry

Prerequisites:

Math 162.01: 161.xx or written permission of department.

Math 263.01: 162.xx or written permission of department.

Catalog Descriptions:

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

162.01: Improper integrals; polynomial approximations and Taylor's theorem; infinite sequences and series; tests for convergence, vectors, lines and planes.

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

Purpose of Course:

The three-course sequence, 161.01, 162.01, 263.01, is equivalent in content to the four-course sequence 151.01, 152.01.01, 153.01, 254.01. 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, 161.01 serves as a substitute for 151.01 and 152.01, 162.01 as a substitute for 153.01, and 263.01 substitutes for 254.01.

Follow-up Course:

Courses in differential equations or linear algebra, possibly 520H, if completed 345 concurrently with 263.

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Math 161.01, 162.01, 263.01
Course Coordinator: B. Pittel
2010-2011

Text:

For 161.01:

Calculus: Early Transcendentals, Volume 1, 6th OSU custom edition, by James Stewart, Cengage, ISBN-13: 978-1-4240-6455-7 or ISBN: 1-4240-6455-4

For 162.01 and 263.01:

Calculus: Early Transcendentals, Volume 2, 6th OSU custom edition, by James Stewart, Cengage, ISBN-13: 978-1-4240-6457-1 or ISBN: 1-4240-6457-0

Alternate Text:

Calculus: Early Transcendentals, 6th edition, by James Stewart, Thomson, ISBN 0534393217.

NOTE: The textbook for the Math 161.01 sequence and the Math 151.01 sequence is the same. The text for the 161.01H sequence is different.

Topics:

161.01: 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.

162.01: Sequences and series, power series, Taylor's theorem, convergence tests, vectors, dot and cross product, lines and planes.

263.01: Surfaces, cylindrical and spherical coordinates, partial derivatives, multiple integrals, line integrals, vector fields, Green's and Stokes' Theorems.

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

Mathematics 161.01H Au
Mathematics 162.01H Wi
Mathematics 263.01H Sp

5 cr. Each

Accelerated Calculus
with Analytic Geometry

Prerequisite:

161.01H - Credit for Math 151.xx, or satisfactory score on Department Qualifying Exam.

162.01H - 161.01H with a grade of C or better or written permission of Honors Committee chair.

263.01H - 162.01H with a grade of C or better or written permission of Honors Committee chair.

Catalog Description:

The catalog descriptions for 161.01H, 162.01H, and H163 are the same as those for 161.01, 162.01, and 263.01 (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 161.01, 162.01, 263.01; it is *designed for students with credit for Math 151.xx*. 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 161.01H is a substitute for 151.01 and 152.01, 162.01H for 153.01, and 263.01H for 254.01.

Follow-up Course:

After completing 263.01H concurrently with 345, students will be ready for Math 520H, 521H and 522H (or various other courses in linear algebra, analysis or differential equations).

Text:

Calculus with Analytic Geometry, 2nd edition, by Simmons, McGraw-Hill, ISBN 007057624

NOTE: The textbooks for the Math 161.01 sequence and Math 151.01 sequence are not the same as 161.01H.

Topics:

161.01H. 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.

162.01H. 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.

263.01H. 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.

Math 161.01H, 162.01H, 263.01H

Course Coordinator: V. Bergelson

2010-2011

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

Mathematics 161.02 Au
Mathematics 162.02 Wi
Mathematics 263.02 Wi, Sp

5 cr.

Accelerated Calculus with
Analytic Geometry I, II, III

Prerequisite:

Students are individually chosen by the College of Engineering.

Math 161.02: Course code L placement and high school calculus.

Math 162.02: 161.02 or written permission of department.

Math 263.02: 162.02 or written permission of department.

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Catalog Description:

161.02:

Functions, limits and continuity, derivatives, applications of the derivative, L'Hopital's Rule, the integral, techniques of integration, applications of the integral.

162.02:

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

263.02:

Multivariable calculus, vector fields, line and surface integrals.

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; 161A, 162A, and 263A in 04-05 and 161.02, 162.02 and 263.02 in 2009.

Text:

Calculus/Early Transcendentals, Volumes 1 & 2, 6th OSU custom edition, by Stewart, Cengage, ISBN-13: 978-1-4240-6455-7 and ISBN-13: 978-1-4240-6457-1

Topics:

Generally, the first quarter is the equivalent of 151.02 and 152.02; the second quarter covers 153.02; and the third quarter covers 254.02, and some additional topics.

Math 161.02, 162.02, 263.02
Course Coordinator: B.Pittel
2010-2011

Mathematics 187.01H

2 cr. Each

Advanced Problem Solving

Mathematics 487H

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.

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Math 187.01H, 487H
Course Coordinator: V. Bergelson
2010-2011

Mathematics 190H Au
Mathematics 191H Wi
Mathematics 264H Sp

5 cr. Each

Elementary Analysis I
Elementary Analysis II
Elementary Analysis III

Prerequisite:

190H: Permission of department
191H: A grade of C or better in 190H
264H: A grade of C or better in 191H

Catalog Descriptions:

190H: The first of an enriched honors calculus sequence designed to introduce students to the mathematical underpinnings of analysis.

191H: Continuation of 190H.

264H: Continuation of 191H; 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 151.01, 152.01, 153.01, 254.01, and 551. 190H - 191H 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 520H, 521H, 522H

Texts:

190H, 191H: Calculus, 4rd edition, by Spivak, Publish or Perish, ISBN 0914098918

264H: Texts vary, for example:

Advanced Calculus, by Folland, Prentice-Hall (used in Sp08, Sp10)

Advanced Calculus of Several Variables, Edwards, Jr. (used Sp05)

Vector Calculus, 4th edition, Marsden/Tromba (used Sp00, Sp03, Sp09)

Continued.

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Math 190H, 191H, 264H
Course Coordinator: V. Bergelson
2010-2011

Topics:

190H - 191H:

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.

264H:

Multivariable calculus (vector approach)
Gradients
Multiple integrals
Line and surface integrals
Green's Theorem
Divergence theorem
Stokes' Theorem.

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**Math 190H, 191H, 264H
Course Coordinator: V. Bergelson
2010-2011**

Mathematics 212
Sp

5 credits

**History of Mathematics
for Middle School Teachers**

Prerequisite:

Math 110 and 111. Open only to middle childhood majors.

Catalog Description:

Historical development of concepts appropriate to middle childhood mathematics. A capstone course to bring together topics discussed in 108, 109, 110, 111 and Statistics 145.

Purpose of Course:

The general goal of this course is to prepare you to become teachers of middle school students. Knowing the mathematics for yourself is not the same as knowing the math for teaching.

Text:

Math through the Ages: A Gentle History for Teachers and Others (Expanded Edition), by Berlinghoff, W. P. & Gouvea, F.Q. (2004). Oxton House Publishers, Mathematical Assn. of America.

Topics List:

- 1 History of whole numbers and fractions
- 2 The Story of π
- 3 Origins of linear thinking: Solving First Degree Equations
- 4 Greek Mathematics.
 - The Pythagorean Theorem
 - Euclid's Plane Geometry
 - The Platonic Solids
- 5 Mathematics in India
 - The Story of Zero
 - Negative Numbers
 - Sine and Cosine
- 6 Arabic mathematics
 - Quadratic Equations
 - Beginnings of algebra
- 7 Medieval Europe
 - Reading & Writing Arithmetic: Where the Symbols Came From
 - Solving Cubic Equations
- 8 The 15th and 16th Centuries
 - Projective Geometry
 - Algebra Comes of Age
- 9 Coordinate Geometry
- 10 Non-Euclidean Geometries
- 11 Calculus and Applied Mathematics
- 12 Rigor and Professionalism
- 13 Abstraction, Computers and New Applications

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Math 212
Course Coordinator: H. Clemens
2010-2011

Mathematics 254.01
Au, Wi, Sp, Su

5 cr.

Calculus and Analytic Geometry IV

Prerequisite:

Mathematics 153.01

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, 6th OSU custom edition, by James Stewart, Cengage, ISBN-1424064571

Alternate Text: Calculus: Early Transcendentals, 6th edition, by James Stewart, Thomson, ISBN 0534393217.

Continued:

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Math 254.01
Course Coordinator: K. Koenig
2010-2011

Topics List & Sample Syllabus:

Week	Sections	Topics
Week 1	14.1	Functions of several variables
	14.2	Limits and continuity
	14.3	Partial derivatives
Week 2	14.4	Tangent planes and linear approximation
	14.5	The chain rule
	14.6	Directional derivatives and the gradient vector
Week 3	14.7	Maximum and minimum values
	14.7,14.8	Max/min values (cont.), Lagrange multipliers
	14.8	Lagrange multipliers (cont.)
Week 4		<i>Midterm 1</i>
	15.1,15.2	Double integrals over rectangles; Iterated integrals
Week 5	15.3	Double integrals over general regions
	15.3	Double integrals over general regions (cont.)
	15.4	Double integrals in polar coordinates
	15.6	Triple integrals
Week 6	15.7	Triple integrals in cylindrical coordinates
	15.8	Triple integrals in spherical coordinates
	16.1	Vector fields
Week 7	16.2	Line integrals
	16.3	Fundamental theorem for line integrals
	16.3	Fundamental theorem for line integrals (cont.)
Week 8		<i>Midterm 2</i>
	16.4	Green's theorem
Week 9	16.4, 16.5	Green's theorem (cont.), Curl and divergence
	16.6	Parametric surfaces and their areas
	16.6	Parametric surfaces and their areas (cont.)
	16.7	Surface integrals
Week 10	16.7-16.9	Stokes' theorem and the divergence theorem [as time permits]
		<i>Review for final exam</i>

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Math 254.01
 Course Coordinator: K. Koenig
 2010-2011

Mathematics 255
Au, Wi, Sp, Su

5 cr.

**Differential Equations
and Their Applications**

Prerequisite:

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

Catalog Description:

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

Purpose of Course:

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

Text:

Elementary Differential Equations and Boundary Value Problems, 8th Edition, by Boyce/DiPrima, Wiley, ISBN 9780470438862

Continued:

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Math 255
Course Coordinator: W. Luo
2010-2011

Topics List:

Sections	Topics	Approximate Time
	Introduction	2 lectures
1.1	Some Basic Mathematical Models; Direction Fields	
1.2	Solutions of Some Differential Equations	
1.3	Classification of Differential Equations	
2.2	Separable Equations	
	First Order Differential Equations	6 lectures
2.1	Linear Equations with Variable Coefficients	
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	5 lectures
3.1	Homogeneous Equations with Constant Coefficients	
3.2	Fundamental Solutions of Linear Homogeneous Equations	
3.3	Linear Independence and the Wronskian	
3.4	Complex Roots of the Characteristic Equation	
3.5	Repeated Roots; Reduction of Order	
3.6	Nonhomogeneous Equations; Method of Undetermined Coefficients	
3.7	Variation of Parameters	
MIDTERM #1		
	Higher Order Linear Equations	6 lectures
4.1	General Theory of nth Order Linear Equations	
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	6 lectures
5.1	Review of Power Series	
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	5 lectures
6.1	Definition of the Laplace Transform	
6.2	Solution of Initial Value Problems	
6.3	Step Functions	
6.4	Differential Equations with Discontinuous Forcing Functions Impulse Functions	
6.6	The Convolution Integral	

Mathematics 345
Au, Sp

4 cr.

Foundations of Higher Mathematics

Prerequisite:

Mathematics 254.xx

Catalog Description:

Designed to prepare students for higher mathematics: an introduction to logic, proof techniques, set theory, number theory, integers, real 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.xx or 263.xx) 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), combinatorial mathematics, graph theory (575), and introduction to mathematical finance (589).

Text:

The Fundamentals of Higher Mathematics, by 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

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Math 345
Course Coordinator: N. Falkner
2010-2011

Mathematics 366 3 cr
Au, Wi, Sp, Su (1st Term)

Discrete Mathematical Structures I

Prerequisite:

Mathematics 132 or 152.xx.

Catalog Description:

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

Purpose of Course:

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

Follow-up Course:

Math 566.

Text:

Discrete Mathematics with Applications, 4rd edition, by S. S. Epp, Cengage, ISBN 0495391328

Continued:

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Math 366
Course Coordinator: T. Carlson
2010-2011

Topics List & Sample Syllabus:

<u>Sections</u>	<u>Topics</u>
	THE LOGIC OF COMPOUND SETS
2.1	Logical Form and Logical Equivalence
2.2	Conditional Statements
2.3	Valid and Invalid Arguments
2.4	Application: Digital Logic Circuits
	THE LOGIC OF QUANTIFIED STATEMENTS
3.1	Introduction to Predicates and Quantified Statements I
3.2	Introduction to Predicates and Quantified Statements II
3.3	Statements with Multiple Quantifiers
3.4	Arguments with Quantified Statements
	ELEMENTARY NUMBER THEORY AND METHODS OF PROOF
4.1	Direct Proof and Counterexample I: Introduction
4.2	Direct Proof and Counterexample II: Rational Numbers
4.3	Direct Proof and Counterexample III: Divisibility
4.4	Direct Proof and Counterexample IV: Division into Cases and the Quotient-Remainder Theorem
4.5	Direct Proof and Counterexample V: Floor and Ceiling
4.6	Indirect Argument: Contradiction and Contraposition
	SEQUENCES, MATHEMATICAL INDUCTION, and RECURSION
5.1	Sequences
5.2	Mathematical Induction I
5.3	Mathematical Induction II
5.4	Strong Mathematical Induction and the Well-Ordering Principle for the Integers
	SET THEORY
6.1	Set Theory; Definitions and the Element Method of Proof
6.2	Properties of Sets
6.3	Disproofs, Algebraic Proofs and Boolean Algebras
	RELATIONS
8.1	Relations on Sets
	FUNCTIONS
7.1	Functions Defined on General Sets
7.2	One-to-One and Onto, Inverse Functions
7.3	Composition of Functions

Mathematics 415.01 4 cr.
Mathematics 415.02
Au, Wi, Sp, Su

**Ordinary and Partial
Differential Equations**

Prerequisite:

Mathematics 254.xx

Catalog Description:

Ordinary, partial, linear and nonlinear differential equations; Fourier series, boundary value problems; and system of first order equations.

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). 415.02 is a course taught in the spring for students in the Freshman Engineering Honors program. Students would have taken 162.02 in Autumn and 263.02 in winter.

Text:

Elementary Differential Equations and Boundary Value Problems, 8th OSU Custom Edition, by Boyce, Wiley, ISBN 9780470438862

-or-

Dr. Baker's lecture notes, Math Print Shop

Topics List:

<u>Section</u>	<u>Topic</u>
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

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Math 415.01, 415.02
Course Coordinator: U. Gerlach
2010-2011

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Continued:

Math 415.01, 415.02

Page 2

2.6	Exact equations	
3.1	Homogeneous equations with constant coefficients	7 days
<hr/>		
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	
3.8	Mechanical and electrical vibrations	
3.9	Forced vibrations	6-7 days
<hr/>		
10.1	Two-point boundary value problems	
10.2	Fourier series	
10.3	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	8 days
<hr/>		
7.1	Systems of first order equations: Linearization at equilibrium – the problem of stability	
7.2-7.3	Matrices, eigenvalues, eigenvectors, phase plane examples in 2-D	
7.4-7.5	Homogeneous linear systems with constant coefficients	
7.6	Complex eigenvalues	5-6 days

* This section can be omitted at the instructor's discretion.

Boyce and DiPrima need concrete motivation leading into Sections:

- 2.1 – 2.6
- 3.1 – 3.9
- 5.1 – 5.2
- 10.1 – 10.7

Students have virtually no background in linear algebra. Consequently, it is best to confine the material in Sections 7.1-7.6 to 2×2 or 3×3 matrices at most.

Math 415.01, 415.02
Course Coordinator: U. Gerlach
2010-2011

Mathematics 504
Sp, Su

5 cr.

History of Mathematics

Prerequisite:

Math Major or grad standing in EdT&L and Mathematics 580, or 520H, or 571, 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.

Text:

The text will be chosen by the instructor. One often used text is Math Through The Ages, Expanded, by Berlinghoff/Gouvea, Oxton House & MAA, ISBN 0883857367.

Topics:

The topics will be chosen by the instructors.

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Math 504
Course Coordinator: TBA
2010-2011

Mathematics 507
Au, Wi

5 cr.

Advanced Geometry

Prerequisite:

Mathematics 264H or 345 or GRAD standing.

Catalog Description:

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 parametric form of length, area and volume formulas from calculus
- II. Review of Euclid's postulates and Euclidean geometry (resurrect high school geometry as the unique complete, flat, 2-dimensional geometry)
- III. Cross-ratio, a projective invariant
- IV. Rigid motions, linear algebra, linear fractional transformations
- V. Intuitive idea of Riemannian geometry (consider 2-dimensional geometries which are possibly 'curved')
- VI. Spherical geometry (a positively curved, complete homogeneous, 2-dimensional geometry)
- VII. Rigid motions in spherical geometry (enough of these is what makes these geometries 'homogeneous')
- VIII. Length and area in spherical geometry
- IX. Hyperbolic geometry (a negatively curved, complete homogeneous, 2-dimensional geometry)
- X. Rigid motions in hyperbolic geometry (enough of these is what makes these geometries 'homogeneous')
- XI. Length and area in hyperbolic geometry

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Math 507
Course Coordinator: H. Clemens
2010-2011

Mathematics 512
Au, Wi, Sp, Su (1st Term)

3 cr.

**Partial Differential Equations
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 with Fourier Series and Boundary Value Problems, 2nd Edition, by Asmar, Pearson, ISBN 0131480960.

Topics List & Sample Syllabus

<u>Sections</u>	<u>Topics</u>	<u>Approximate Time</u>
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.

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Math 512
Course Coordinator: S. Tanveer
2010-2011

Mathematics 513
Au, Wi

3 cr.

Vector Analysis for Engineers

Prerequisite:
Mathematics 254

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

Purpose of Course:
A basic 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, 7th edition, by Davis and Snider, Quant Systems, ISBN 0697160998.

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

Continued.

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Math 513
Course Coordinator: U. Gerlach
2010-2011

Topics List & Sample Syllabus:

<u>Sections</u>	<u>Topics</u>	<u>Approximate Time</u>
1.1-1.13	Review vector algebra, geometry, Dot and cross products, lines and planes	4 days
1.15 *	Tensor notation	
2.1-2.3	Vector functions of one variable, arc length,	5 days
2.4 optional **	Velocity, acceleration, curvature	
2.5 *	Tensor notation	
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

* Sections 1.15 and 2.5, on tensor notation, introduce the index notation, which, even through very useful to physicists and engineers, can be omitted at the discretion of the instructor.

** Section 2.4 lends itself to a quick, beautiful, and culturally important exemplar of inductive reasoning: the derivation of Newton's law of universal gravitation from Kepler's three laws. See e.g. <http://www.math.ohio-state.edu/~gerlach/Newton>

In light of this importance, it is recommended that the instructor present this derivation, even though it is unlikely to be part of a midterm exam.

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, which can actually be of considerable benefit. It does not include any applied science applications from fluid mechanics or electricity and magnetism, for example. But that could be remedied by the responsible instructor.

(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
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Math 513
Course Coordinator: U. Gerlach
2010-2011

Mathematics 514
Sp

3 credits

Complex Variables for Engineers

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, 8th edition, by Brown/Churchill, McGraw-Hill, ISBN 0072872527

Possible Alternative Text:

Advanced Engineering Math, 9th edition, by Kreyszig. Kreyszig contains much diverse material. It is an excellent reference for engineers on many topics in mathematics.

Continued:

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Math 514
Course Coordinator: F. Tian
2010-2011

Sample Syllabus #1: (Based on Churchill)

Topics	Approximate Time (days)
Complex numbers, polar form	3
Analyticity, Cauchy-Riemann equations	3
Elementary functions	4
	<i>TEST</i>
Mapping by elementary functions	3
Cauchy integral theorem and consequences	5
	<i>TEST</i>
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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Math 514
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 2010-2011

Mathematics 520H Au
Mathematics 521H Wi
Mathematics 522H Sp

5 cr. Each

Linear Algebra
Differential Equations
Complex Analysis

Prerequisites:

520H: 263.01H or 264H

521H: 520H

522H: 521H

Or written permission of Honors Committee chairperson.

Catalog Descriptions:

520H: Vector spaces, linear transformations, systems of equations, determinants, eigenvalues, spectral theorem, Cayley-Hamilton theorem.

521H: Ordinary, linear and nonlinear differential equations, existence and uniqueness theorems, Fourier series, boundary value problems, systems, Laplace transforms, phase space, stability and periodic orbits.

522H: 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 255.01 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: 520H

Linear Algebra: An Introductory Approach, 4th Revised Edition, by Curtis, Springer, ISBN 387909923 (used Au03-Au09)

Linear Algebra and Its Applications, by Strang (used 2000)

Winter: 521H

An Introduction to Ordinary Differential Equations, by Coddington, Dover, ISBN 0486659429 (used Wi09-Wi09)

Differential equations with Applications & Historical Notes, 2nd Edition, by Simmons (used Wi05)

Nonlinear Dynamics and Chaos, by Strogatz (used Wi01)

Spring: 522H

Elementary Theory of Analytic Functions of One or Several Complex Variables, by H. Cartan, Dover, ISBN 0486685438 (used Sp07-Sp09)

Complex Analysis, 2nd edition, by Bak-Newman (used 2005-2006)

Complex Analysis with Applications, by Silverman (used Sp03)

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Math 520H, 521H, 522H
Course Coordinator: V. Bergelson
2010-2011

Mathematics 530
Au

3 cr.

Probability

Prerequisite:

Mathematics 254.

Catalog Description:

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

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, by Jim Pitman, Springer, ISBN 9780387979748.

Topics:

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

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**Math 530
Course Coordinator: N. Falkner
2010-2011**

Mathematics 531H
Au

5 credits

Rigorous Probability

Prerequisite:

Math 264H

Catalog Description:

A rigorous honors course on probability theory with special attention to applications within and outside mathematics.

Purpose of Course:

The acquaintance with rigorous probability theory, its history and its multiple connections, will better prepare these high quality students for graduate studies and will help them get involved in research at earlier stages of their careers.

Texts vary, for example:

Heads and Tails. An Introduction to Limit Theorems in Probability, E. Lesigne, AMS, ISBN 0821837141

Elementary Probability Theory with Stochastic Processes, Kai Lai Chung

Probability Theory - A Concise Course, Y. Rosanov

The Pleasures of Probability, Richard Isaac

Statistical Inference in Probability, Analysis and Number Theory, M. Kac.

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Math 531H
Course Coordinator: V. Bergelson
2010-2011

Mathematics 532
Sp

3 cr.

**Mathematical Foundations
of Actuarial Science**

Prerequisite:

Mathematics 530 or Statistics 420 or Mathematics 531H, or permission of instructor.

Catalog Description:

Problem workshop for applications of calculus and probability to actuarial science and 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 Study Manual, 2008 edition, by Broverman, Actex Publications.

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Math 532
Course Coordinator: C. Ban
2010-2011

Mathematics 540H Wi*
Mathematics 541H Sp*

5 cr.

Geometry and Calculus in Euclidean
Spaces and on Manifolds I & II

* Offered odd numbered years

Prerequisite:

Mathematics 263.01H or 264H, 520H, 521H, or permission of the instructor

Catalog Description:

The topology of n-dimensional Euclidean space, differentiation of vector-valued functions, inverse and implicit function theorems, Riemann and Lebesgue integration in n-dimensional Euclidean space.

Purpose of Course:

The 540H, 541H sequence 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 541H.

Texts vary, for example:

Differential Geometry of Curves and Surfaces, DoCarmo, (used 2003-2009)

Elements of Differential Geometry, R. Milman and G. Rarker

Elementary Topics in Differential Geometry, Thorpe (used 2005)

A First Course in Geometric Topology and Differential Geometry, E. Bloch (used 2007)

Topics for 540H-541H:

Geometry of curves, surfaces, and higher dimensional manifolds

Curvature

Geodesics

The Gauss Bonnet Theorem

Mapmaking

Riemannian metrics

Non-Euclidean geometries.

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Math 540H, 541H
Course Coordinator: V. Bergelson
2010-2011

Mathematics 547
Au, Wi

3 cr.

Introductory Analysis I

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 edition, by Bartle/Sherbert, Wiley, ISBN 0471321486

Topics:

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

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Math 547
Course Coordinator: P. Nevai
2010-2011

Mathematics 548
Wi, Sp

3 cr.

Introductory Analysis II

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 edition, by Bartle/Sherbert, Wiley, ISBN 0471321486

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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Math 548
Course Coordinator: P. Nevai
2010-2011

Mathematics 549
Au, Sp

3 cr.

Introductory Analysis III

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 edition, by Bartle/Sherbert, Wiley, ISBN 0471321486.

Topics:

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

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Math 549
Course Coordinator: P. Nevai
2010-2011

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, 2nd Edition, by Thomas H. Barr, Prentice-Hall, ISBN 0130880051

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.

<u>Sections</u>	<u>Topics</u>	<u>Approximate Time</u>
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).

Mathematics 556 Wi
Mathematics 557 Sp

3 cr.

Differential Equations I
Differential Equations II

Prerequisite:

Mathematics 255 or equivalent

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Catalog Description:

556: Qualitative theory of ordinary differential equations, including phase plane analysis, stability, oscillations and bifurcations, with applications to the biological and physical sciences.

557: An introduction to the basic properties of partial differential equations and to the techniques for analyzing them.

Purpose of Courses:

This sequence is designed to introduce students to mathematical methods for analyzing both ordinary and partial differential equations. Students will also learn how to use these methods to study mathematical models that arise in the applied sciences.

Text:

556: Nonlinear Dynamics and Chaos: With Applications to Physics, Biology, Chemistry, and Engineering, by Steven Strogatz, Perseus Books Group. ISBN 0-7382-0453.

557: Partial Differential Equations: An Introduction, by Walter Strauss, ISBN 0470054567.

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Math 556, 557
Course Coordinator: D. Terman
2010-2011

Mathematics 566
Au, Wi, Sp, Su (2nd Term)

3 cr.

**Discrete Mathematical
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, and 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, 4th Edition, by S. S. Epp, Thomson, ISBN 0534359450

Continued.

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Math 566
Course Coordinator: T. Carlson
2010-2011

Topics List and Sample Syllabus:

<u>Sections</u>	<u>Topics</u>
	FLOOR AND CEILING FUNCTIONS
4.5	Direct Proof and Counterexample V: Floor and Ceiling
	RECURSION
5.6	Defining Sequences Recursively
5.9	General Recursive Definitions and Structural Induction
	O-NOTATION
11.1	Real-Valued Functions of a Real Variable and Their Graphs
11.2	O, Omega and Theta Notations
11.3	Application: Analysis of Algorithm Efficiency I
11.4	Exponential and Logarithmic Functions: Graphs and Orders
HANDOUT:	Summations
HANDOUT:	Recurrence and Rate of Growth
	RELATIONS
8.1	Relations on Sets
8.2	Reflexivity, Symmetry, and Transitivity
8.3	Equivalence Relations
8.5	Partial Order Relations
	COUNTING
9.1	Introduction
9.2	Possibility Trees and the Multiplication Rule
9.3	Counting Elements of Disjoint Sets: The Addition Rule
9.5	Counting Subsets of a set: Combinations
9.7	Pascal's Formula and the Binomial Theorem
	GRAPHS AND TREES
10.1	Graphs: Definitions and Basic Properties
10.2	Trails, Paths and Circuits
10.3	Matrix Representations of Graphs
10.4	Isomorphisms of Graphs
10.5	Trees
10.6	Rooted Trees
10.7	Spanning Trees (omit discussion of Kruskal's algorithm and Prim's algorithm)
HANDOUT:	Planar Graphs
HANDOUT:	Graph Coloring

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Mathematics 568
Au, Wi, Sp, Su (1st Term)

3 cr.

Introductory Linear Algebra I

Prerequisite:

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

Catalog Description:

The n-dimensional Euclidean space and its subspaces; matrices as mappings; matrix algebra; systems of equations; determinants; dot product; geometric interpretations.

Purpose of Course:

Math 568 is a concrete introduction to linear algebra for students who have completed a four-quarter calculus sequence, and serves as their introduction to mathematics as a deductive discipline. The primary purpose of the course is to introduce students to the linear algebraic algorithms which are vital for the solution of many mathematical and scientific problems – row reduction of linear systems, least squares approximations, and eigenvalue/eigenvector analysis. A gentle introduction to mathematical abstraction and proof is a secondary goal.

Follow-up Course:

None.

Text:

Linear Algebra: A Modern Introduction, 3rd Edition, by Poole, Cengage

Continued:

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Math 568
Course Coordinator: R. Solomon
2010-2011

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, 1 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 $N \times N$ matrix
- 4.4 Similarity and Diagonalization
- 4.6 An application or two (ad libitum)

Chapter 5 Orthogonality (2 weeks)

- 5.1 Orthogonality in \mathbb{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)

DEPARTMENT OF MATHEMATICS
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Mathematics 571
Au, Wi, Sp, Su (1st Term)

3 cr.

Linear Algebra for Applications I

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 with Applications, 7th edition, by S. Leon, Pearson, ISBN 0131857851

Linear Algebra Labs with Matlab, 3rd edition, by Hill/Zitarelli, Pearson, ISBN 0131432745

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:

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

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Math 571
Course Coordinator: E. Overman
2010-2011

Mathematics 572
Wi, Su (2nd Term)

3 cr.

**Linear Algebra for
Applications II**

Prerequisite:

Math 571 or written permission of the department.

Catalog Description:

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

Text:

Linear Algebra Labs with Matlab, Hill & Zitarelli, 3rd edition
Linear Algebra with Applications, S. Leon, 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:

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

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Math 572
Course Coordinator: E. Overman
2009-2010

Mathematics 573
Sp (offered odd numbered years)

5 cr.

Elementary Number Theory

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, 5th edition, Niven/Zuckerman/Montgomery (or equivalent)

Topics:

1. Divisibility properties of integers, primes, Euclidean algorithm, unique factorization, greatest common divisors, least common multiples.
2. Linear Diophantine equations.
3. Congruences, Euler's function, Euler-Fermat Theorem, primitive roots.
4. Linear congruences, Chinese Remainder Theorem, quadratic congruences, Quadratic Reciprocity Law.
5. Optional Topics: Pythagorean Triples, sums of squares, cryptography, elliptic curves, higher degree Diophantine equations.

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Math 573
Course Coordinator: W. Sinnott
2010-2011

Mathematics 575 **5 cr.**
Wi, Sp (*offered even numbered years*)

Combinatorial Mathematics & Graph Theory

Prerequisite:

Mathematics 568.

Catalog Description:

Some classical puzzles of recreational mathematics; 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-exclusion
The pigeonhole principle
Graphs
Edge- and vertex- colorings
Chromatic polynomials
Matchings
Latin squares
Finite projective planes
Block designs
Symmetric block designs.

Continued:

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Math 575
Course Coordinator: S. Milne
2010-2011

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

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Math 575
Course Coordinator: S. Milne
2010-2011

Mathematics 576H Wi*
Mathematics 577H Sp*

5 cr. each

Number Theory
Through History I, II

**Offered even numbered years*

Prerequisite:

576H: 190H, 191H, and 520H, or written permission of Honors Committee chair.

577H: 576H or written permission of Honors Committee chair.

Catalog Description:

576H:

The integrated honors sequence 576H-577H includes elementary analytic and algebraic number theory and traces its unifying role in development of mathematics through history.

577H:

Continuation of 576H.

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. Zuckerman, H.L. Montgomery

Number Theory: An Introduction to Mathematics, Parts A and B, by William A. Coppel, Springer-Verlag.

Continued.

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Math 576H, 577H
Course Coordinator: V. Bergelson
2010-2011

Suggested Topics List:

576H:

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. Champernown's example. Almost every number is normal. Levy-Khinchine Theorem on normality of continued fractions.

577H:

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.).

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 graph theory, linear optimization, Markov chains and queues.

Purpose of Course:

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

Text:

"Discrete Mathematics" (Second Edition) by Norman L Biggs.

Other References:

Discrete Dynamical Systems, Sandefur

Mathematical Modeling, Maki & Thompson

Applying Mathematics, Burghes, Huntly & McDonald

Computer Simulation, Nancy Roberts et al, Addison-Wesley

Applications of Linear Algebra, Anton & Rorres, Wiley

An Introduction to Mathematical Models, Olinick

A variety of different modules available through COMAP

A First Course in Mathematical Modeling, (Second Edition), Giordano, Weir & Fox, Brooks/Cole Publishing Company

Topics:

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

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Math 578
Course Coordinator: D. Ray-Chaudhuri
2010-2011

Mathematics 580 Au, Wi 3 cr. Each
Mathematics 581 Wi, Sp
Mathematics 582 Sp, Au

Algebra I
Algebra II
Algebra III

Prerequisite:

580: Mathematics 568, 571 or 520H and Mathematics 345.

581: Mathematics 580 or 590H

582: Mathematics 581 or 591H

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, geometric 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:

Shapes, Numbers, and Polynomials, lecture notes by Ronald Solomon.

Topics:

580: Groups; Group actions and symmetry.

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

582: Field extensions; Introduction of Galois Theory.

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Math 580, 581, 582
Course Coordinator: R. Solomon
2010-2011

Prerequisite:

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

Catalog Description:

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

Purpose of Course:

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

Text:

No textbook is required. Course material will be prepared by the lecturers.

Topics:

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

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Math 588
Course Coordinator: C. Ban
2010-2011

Mathematics 590H Au
Mathematics 591H Wi
Mathematics 592H Sp

5 cr. Each

Algebraic Structures I
Algebraic Structures II
Algebraic Structures III

Prerequisite:

590H: 520H with a grade of C or better, or written permission of Honors Committee Chair
591H: 590H with a grade of C or better, or written permission of Honors Committee Chair
592H: 591H 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 590H, 591H, 592H sequence substitutes for the sequence 580, 581, 582.

Text:

Vary, for example:

Abstract Algebra, by D. Dummit and R. Foote (2004-2007)

Algebra, by M. Artin

Topics in Algebra, by I. Herstein

Suggested Topics:

590H:

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.

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Math 590H, 591H, 592H
Course Coordinator: V. Bergelson
2010-2011

591H:

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.

592H:

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.

**DEPARTMENT OF MATHEMATICS
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Mathematics 601
Au

3 cr.

**Mathematical Principles
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:

Linear Algebra and its Applications, 4th Edition, by Strang, Cengage, ISBN 978003010568 (chapter 5). However later editions are also okay.

Introduction to Linear Algebra, Johnson, Riess & Arnold, (chapter 4)

Website:

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

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Math 601
Course Coordinator: U. Gerlach
2010-2011

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
Orthogonal 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)

Mathematics 602
Wi

3 credits

Mathematical Principles in
Science II

Prerequisite:

Mathematics 601

Catalog Description:

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

Purpose of Course:

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

Follow-up Course:

Math 603.02

Possible Topics and Texts:

- I. Eigenvalues and eigenvectors:
Linear Algebra and its Applications, Strang, 3rd edition, (Ch. 5, 6, and Appendix A)
- II. Infinite-dimensional vector spaces:
Linear Mathematics in Infinite Dimensions, U. Gerlach, (Ch. 1 and 3)
Fourier Series and Boundary Value Problems, Churchill and Brown, (Ch. 3)
Mathematical Methods in Physics and Engineering, Dettman, (Ch. 2)
Website: <http://www.math.ohio-state.edu/~gerlach/math>

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Math 602
Course Coordinator: U. Gerlach
2010-2011

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, Parseval's equality and completeness
Unitary transformation between Hilbert spaces

(*1 day = one 48 min. lecture)

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Math 602
Course Coordinator: U. Gerlach
2010-2011

Mathematics 603.02
Sp

3 cr.

Mathematical Principles in
Science III

Prerequisite:

Some complex analysis. Mathematics 514 would be sufficient.

Catalog Description:

An introduction to partial differential equations (pdes) that arise in the mathematical and engineering sciences. Mathematical principles and methods in the physical and engineering sciences including Fourier theory, Green's function theory, study of pdes illustrated mainly by the Helmholtz equation.

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>

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Math 603.02
Course Coordinator: U. Gerlach
2010-2011

Topics List:

I. FOURIER THEORY

(I & II approximately 20 days)*

Fourier series

Dirichelet kernel

Fourier's Theorem on a finite domain

Sequences leading to the Dirac delta function

Fourier transform representation

Change of basis in Hilbert space:

Orthonormal wavelet and wavepacket representations

II. GREEN'S FUNCTION THEORY: INHOMOGENEOUS DIFFERENTIAL EQUATIONS

Homogeneous systems

Adjoint systems

Inhomogeneous systems

The concept of a Green's function

Solution via Green's function

Integral equation of a linear system via its Green's function

Classification of integral equations

The Fredholm alternative

Green's function and the resolvent of the operator of a system

Eigenfunctions and eigenvalues via residue calculus

Branches, branch cuts, and Riemann sheets

Singularity structure of the resolvent of a system:

Poles and branch cuts

Effect of boundary conditions and domain size

III. THEORY OF SOLUTIONS TO PARTIAL DIFFERENTIAL EQUATIONS IN TWO AND THREE DIMENSIONS

(approximately 10 days)

Partial differential equations: hyperbolic, parabolic, and elliptic

The Helmholtz equation and its solutions in the Euclidean plane

Geometry of the space of solutions

Plane waves vs. cylinder waves:

Why, and when to use them

Sommerfeld's integral representation

Hankel, Bessel, and Neumann waves

Change of basis in the space of solutions: partial waves

Displaced cylinder waves

The Cylindrical Addition Theorem

Method of steepest descent and stationary phase

Analytic behavior of cylinder waves

Interior (cavity) and exterior (scattering) boundary value problems

Cauchy problem and characteristics

Spherical waves: symmetric and nonsymmetric

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

Mathematics 615	Au	3 cr.	Applied Differential Equations I
Mathematics 616	Wi	3 cr.	Applied Differential Equations II
Mathematics 617	Sp	3 cr.	Applied Differential Equations III

Prerequisite:

Mathematics 255 and linear algebra.

Catalog Description:

615: An applied course emphasizing modeling by differential equations of physical and biological processes. Topics include explicit solutions, existence and uniqueness, n-dimensional linear ODE systems, geometric theory, bifurcation analysis.

616: An introduction to the basic types of partial differential equations and their solutions, including the methods of separation of variables and Fourier transform. Applications to problems in physics and biology.

617: Topics in applied ODEs and PDEs. Possible topics include solution of the Dirichlet problem in general domains, integral equations, nonlinear PDEs, chaotic dynamics, singular perturbations.

Purpose of Courses:

This sequence provides students with an understanding of how ordinary and partial differential equations are derived as mathematical models as well as how these systems may be analyzed and interpreted within the context of applications. The courses are designed around examples in mechanics and biology, emphasizing how the mathematical development and bifurcation theory helps one gain better understanding of the physical and biological models.

Text:

615: Nonlinear Dynamical Systems and Chaos, by Strogatz, Westview Press

616: Partial Differential Equations: Analytical and Numerical Methods, Mark S. Gockenbach. SIAM, 2002.

617: Text will be chosen by instructor.

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Math 615, 616, 617
Course Coordinator: J. Best
2010-2011

Mathematics 618
Au

4 cr.

Theory of Interest

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, introduction to derivatives.

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 and financial economics 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, 4th Edition, by Samuel A. Broverman, ASA, Ph.D., Actex Publications.
- Derivatives Markets, 2nd Edition, by Robert L. McDonald, Addison Wesley.

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.
9. Introduction to derivatives.
10. Forwards and options, insurance, collars, and other strategies.
11. Risk management.

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**Math 618
Course Coordinator: C. Ban
2010-2011**

Mathematics 630 Au
Mathematics 631 Wi
Mathematics 632 Sp

4 cr.

Actuarial Mathematics I
Actuarial Mathematics II
Actuarial Mathematics III

Prerequisite:

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

Catalog Description:

630: Problem workshop for applications of economics, finance, and theory of interest to actuarial science.

631: Actuarial models and their application to insurance and other financial risks.

632: Actuarial models and their application to insurance and other financial risks.

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, by Newton L. Bowers, Jr., et al, Society of Actuaries, ISBN 0938959107.

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Math 630, 631, 632
Course Coordinator: R. Evans
2010-2011

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
Mathematics 652 Wi
Mathematics 653 Sp

Introduction to Real Analysis I
Introduction to Real Analysis II
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

Text:

Mathematical Analysis: An Introduction, by Browder, Springer, ISBN 0387946144

Other Possible Texts:

Principles of Mathematical Analysis, 3rd Edition, by Rudin, McGraw-Hill, ISBN 0070856133.

or:

Introduction to Real Functions and Orthogonal Expansions, by B. Sz.-Nagy, (used 1998-2001)

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:

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Possible Texts – cont.:

or:

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

or:

An Introduction to Classical Real Analysis, K. Stromberg, (used 1994-95 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, by S. Berberian

651: Chapters 1-4, 10

652: Chapters 5-9

653: Chapter 11 and supplementary material

or:

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

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**Math 651, 652, 653
Course Coordinator: P. Nevai
2010-2011**

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. 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, product spaces, quotient spaces, connectedness in metric and general topological spaces, surface manifolds, cell complexes.

656:

Continuation of 655; the fundamental group and covering spaces.

657:

Continuation of 656: homology.

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:

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Math 655, 656, 657
Course Coordinator: Z. Fiedorowicz
2010-2011

Text:

Topology, 2nd Edition, by Munkres, Pearson, ISBN 0131816292

Other Possible Texts:

A Basic Course in Algebraic Topology, 2nd Edition, by Massey/Armstrong, Springer-Verlag, ISBN 0387908390 (used 1991, 2007).

Algebraic Geometry, 3rd Edition, by Hatcher, Cambridge, ISBN 0521795400

An Introduction to Algebraic Topology, Rotman

Basic Topology, by M. A. Armstrong, Springer-Verlag, 1994.

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>

Mathematics 665
Mathematics 666

Wi
Sp

4 cr. Each

Modern Mathematical Methods
In Relativity Theory I, II

(NOTE: Offered alternate years. In 2009, Math 665 in Spring only, Math 666 in Autumn only.)

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 space-time; physical interpretations; tensors; exterior calculus, manifolds; Lie derivatives; parallel transport; torsion; curvature; Cartan's two structural equations; Einstein Field equations.

666: Fluid dynamics, Hamilton-Jacobi theory in curved geometries; geometry and dynamics of homogeneous cosmologies; black holes; local-global properties; entropy; gravitational collapse, space-time symmetries.

Purpose of Course:

To develop an appreciation and the modern machinery for the description of the space-time continuum with emphasis on (1) the underlying differential geometric framework of space-time, 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 space-time.

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

Website:

For a detailed syllabus, see <http://www.math.ohio-state.edu/~gerlach/math665>.

Continued:

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Math 665, 666
Course Coordinator: U. Gerlach
2010-2011

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

Mathematics 670 Au
Mathematics 671 Wi
Mathematics 672 Sp

5 cr. Each

Algebra I
Algebra II
Algebra III

Merged with the 590H sequence, please refer to 590H.

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".

Purpose of Course:

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

DEPARTMENT OF MATHEMATICS
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Math 670, 671, 672
Course Coordinator: V. Bergelson
2010-2011

Mathematics 701
Wi (*offered alternate years*)

5 cr.

**Mathematical Principles in Science III:
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, Dover, ISBN 0486414485
Selected sections from Gravitation by C.S. Misner, K.S. Thorne, and J.A. Wheeler

Website:

<http://www.math.ohio-state.edu/~gerlach/math>
Click on Mathematics 701.

Continued.

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Math 701
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Topics:

(I)

Classical problems in the calculus of variations

Euler's equation

Constraints and isoperimetric problems

Variable end point problems

Geodesics

Hamilton's principle, Lagrange's equations of motion

Hamilton's equations of motion, phase space

Action as the dynamical phase of a wave, the equation of Hamilton and Jacobi

Particle motion in the field of two attractive centers

Helmholtz's equation in arbitrary curvilinear coordinates

Rayleigh's quotient and the Rayleigh-Ritz method

(II)

Vectors, covectors and reciprocal vectors

Multilinear algebra

Tensors and tensor products

Commutator of two vector fields

Parallel transport of vectors on a manifold, the covariant differential

Derivative of vectors and tensors

Strain-induced parallel transport in an elastic medium

Strain as a deformation in the metric

Parallel transport induced by a metric

Curvature

Tidal acceleration and the equation of geodesic deviation

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