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Mathematics 050
A, W, Sp, Su

5 cr.

Precollege Mathematics I

Prerequisite:
Course Code T on Math Placement Test.

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

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

Follow-up Course:
Math 075 or Math 104

Sequencing Chart:

105 —> 116
075 —> 116
050 —> 130 —> 131
104 —> 148 —> 150 —> 151

Text:

(Over for Topics List and Sample Syllabus)
## Topics List & Sample Syllabus

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Symbols and Sets of Numbers  
Fractions  
Exponents and Order of Operations  
Introduction to Variable Expressions and Equations  
Adding Real Numbers; Subtracting Real Numbers  
Multiplying and Dividing Real Numbers |
| 2.1-2.9  | EQUATIONS, INEQUALITIES, AND PROBLEM SOLVING  
Simplifying Algebraic Expressions  
The Addition and Multiplication Property of Equality  
Solving Linear Equations  
An Introduction to Problem Solving  
Formulas, Percent and Problem Solving  
Further Problem Solving  
Solving Linear Inequalities |
| 1.9, 3.1-3.4 | GRAPHING  
Reading Graphs  
The Rectangular Coordinate System  
Graphing Linear equations  
Intercepts; Slope; Graphing Linear Inequalities |
| 4.1-4.6  | EXPONENTS AND POLYNOMIALS  
Exponents  
Addition and Subtraction of Polynomials  
Multiplication of Polynomials, Special Products |
| 5.1-5.7  | FACTORING POLYNOMIALS  
The Greatest Common Factor and Factoring by Grouping  
Factoring Trinomials  
Factoring Binomials  
Choosing a Factoring Strategy |

### Review and 1st Midterm
- Negative Exponents and Scientific Notation  
- Division of Polynomials

### Review and 2nd Midterm
- Solving Quadratic Equations by Factoring  
- Quadratic Equations and Problem Solving

### Review and Final Exam

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

Course Coordinator:  
Lee McEwan  
2002-2003
Mathematics 075 4 cr. Precollege Mathematics II
A, W, Sp, Su

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

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

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

Follow-up Courses:
Math 104 for students switching to science, computer science, business or engineering curriculum.

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

Sequencing Chart:

- 105 → 106
- 075 → 116
- 050 → 130 → 131
- 104 → 148 → 150 → 151

Text:
Beginning Algebra, (3rd ed.) Martin-Gay

(Over for Topics List & Sample Syllabus)
## Topics List & Sample Syllabus

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  - Simplifying rational expressions  
  - Multiplying and dividing rational expressions  
  - Adding and subtracting rational expressions  
  - Least common denominator  
  - Simplifying complex fractions  
  - Solving rational equations  
  - Ratio and proportion  
  - Rational equations and problem solving  |
| 3.4, 7.1, 7.2 | LINEAR EQUATIONS  
  - Slope  
  - Slope-intercept form  
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| 8.1–8.4  | SYSTEMS OF LINEAR EQUATIONS  
  - Solving systems of linear equations by graphing  
  - Solving systems of linear equations by substitution  
  - Solving systems of linear equations by elimination  
  - Systems of linear equations and problem solving  
  - Systems of linear inequalities  |
| 3.5, 8.5 | LINEAR EQUATIONS  
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| 9.1–9.7  | ROOTS AND RADICALS  
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  - Solving equations containing radicals  
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  - Rational exponents  |
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  - Solving quadratic equations by the square root method  
  - Solving quadratic equations by completing the square  
  - Solving quadratic equations by the quadratic formula  |
| 10.5     | COMPLEX SOLUTIONS OF QUADRATIC EQUATIONS |

Review and first midterm

Review and second midterm

Review and third midterm

Review and final exam

Course Coordinator: Brian McEnnis  
2002-2003

DEPARTMENT OF MATHEMATICS  
THE OHIO STATE UNIVERSITY  
231 WEST EIGHTH AVENUE  
COLUMBUS, OHIO 43210-1174
Prerequisite:
At least one year of high school algebra, out of high school for 5 or more years at time of university enrollment, no formal training in Math in the past 5 years, and written permission of the Department of Mathematics.

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

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

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

Sequencing Chart:

\[\text{050} \rightarrow 104 \rightarrow 148 \rightarrow 150 \rightarrow 151\]

\[\text{075} \rightarrow 116\]

\[\text{105} \rightarrow 106\]

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

(Over for Topics List)
Topics List

1. Arithmetic of signed numbers

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

3. Word problems

4. Solving linear equations and inequalities

5. Graphs of equation

6. Linear equations
   standard form; slope - intercept form

7. Parallel and perpendicular lines

8. Systems of linear equations

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

10. Factoring polynomials
    common monomial factor
    quadratics
    by grouping

11. Rational roots and factors

12. Fractional exponents

13. Simplifying radical expressions

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

15. Negative exponents

16. Simplifying rational expressions

17. Solution of fractional equations and applications
Catalog Description:
Supplement to Math 104 using small-group student-centered active learning to create a new paradigm for learning mathematics.

Prerequisite:
New first quarter freshman, no math admission condition, optional for Math Placement T and mandatory for Math Placement S; Concurrent enrollment in Math 104 required.

Purpose of Course:
This course offers an opportunity for at-risk NFQF [Math Course Code T and S] to develop the skills needed to learn Math. Enrollment in 103 enables code T students to concurrently enroll in Math 104, in place of registration in Math 050. Math 103 was offered in Au 94, Au 95, Au 96, and Au 97 under the Math 194A course number.

Follow-up course:
Students in 103 who also successfully complete 104 are then eligible for 116, 130 or 148.

Text:
Materials used parallel the content of Math 104 while enhancing students’ ability to “process” and “strategize” the mathematics.
Mathematics 104
A, W, Sp, Su

5 cr. Basic College Mathematics

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

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

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

Follow-up Course:
Math 130 or 148.

Sequencing Chart:

050 → 104 → 148 → 150 → 151

075 → 116

105 → 106

130 → 131

Text:
ISBN 0-534-38125-1

(Over for Topics List and Sample Syllabus)
# Topics List & Sample Syllabus

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**Review and Exam 2**

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Mathematics 105 5 cr.
A, W

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

Prerequisite:

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

Catalog Description:

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

Purpose of Course:

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

Follow-up Course:

Math 106

Text:

Mathematics for Elementary Teachers, 5th Ed., Musser & Burger; (lecture/recitation format)
OSU Math 105 Supplements/Labs

Published notes (workshop format)

(Over for Topics List)
Topics List for Math 105

I. Foundations
   A. Sets
      • what is a set; notation, extension property; Venn diagrams
      • subsets, unions, intersections, complements
   B. Logic
      • informal logic; formal logic; and truth tables and deduction
   C. Operations (see Whole Numbers, below)

II. Whole Numbers and Their Properties
   A. Counting
      • one-to-one correspondence; inclusion-exclusion; cartesian products
   B. Factors
      • prime numbers, unique prime factorization, counting factors
      • LCM: how to obtain it; properties of the LCM
      • GCD: how to obtain it; properties of the GCD
   C. Negative Numbers
      • interpretation and rules for manipulation
   D. Properties of Operations
      • abstract operations: commutativity, associativity, identities, inverses
      • properties (and consequences) of: addition, multiplication, subtraction, and division
      • distributivity
   E. Place Value
      • how our numeration system works and other bases
      • algebraic representation of numbers in terms of their digits
      • negative place value and decimals (see Decimals, below)
   F. Common Algorithms
      • understanding algorithms; justification of addition, multiplication, subtraction, division

III. Division and Fractions
   A. Division
      • inverse of multiplication, repeated subtraction, division algorithms and fractions.
   B. Ratio and Proportion
      • proportionality word problems; recognizing given data in terms of proportion
      • cross-multiplication and its justification
   C. Fractions
      • models of fractions; equivalent fractions and cross-multiplication; mixed vs. improper fractions
      • adding and subtracting fractions; multiplication and division of models and procedures.
   D. Decimals
      • place value; terminating decimals to fractions; classification of fractions as terminating or repeating decimals
   E. Scientific Notation
      • definition and conversion; estimation of physical qualities, approximate computation in scientific notation, and logarithmic scale (intro)
   F. Percentages
      • representation as a fraction or decimal; percentage increase or decrease

IV. General Skills and Attitudes
   A. Problem Solving Strategies
      • trial and error; reducing the problem; numbers instead of variables; harnessing physical intuition
   B. Generalization and Abstraction
      • observing patterns; expressing observations; using variables to express and justify observations; broadening the scope
   C. Word Problems
      • understanding what is asked; unambiguous usage of variables; units; writing equations
   D. Broader Context
      • NCTM Standards for active learning, justification/proof, verbalizing; articulate and grammatical mathematical expression; argumentation

Course Coordinator:
Robin Pemantle
2002-2003
Mathematics 106
Wi, Sp

5 cr.
Fundamental Mathematics Concepts for Teachers II

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

Prerequisite:

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

Catalog Description:

Continuation of 105.

Purpose of Course:

To develop an appreciation of, and basic competency in, the use of analytical thought in the development of a cohesive body of useful mathematical knowledge, with special emphasis on topics encountered in elementary and middle school mathematics programs. Math 106 introduces length, area, volume, angle, Euclidean geometry, congruent and similar triangles, symmetry and rigid motion, and knowledge of general spatial skills.

Follow-up Course:

Math 107

Text:

OSU Math 106 Supplements/Labs

Published Notes (workshop format)
Topics List for Math 106

I. Length
   A. Measurement
      • need for standard units; units and comparison; successful measurement
   B. Length and Distance
      • length of a curve; distance in cartesian coordinates
   C. Behavior under Scaling and Change of Units

II. Area
    A. Defining Area
       • conservation of area; comparing by dissecting and rearranging pieces; areas of irregular shapes;
         units of area; surface area
    B. Area Formulae
       • rectangles; triangles; justification of formulae (parallelogram/trapezoid/circle); applications
    C. Behavior under Scaling and Change of Units
       • proportionality to the square; two-dimensionality; independence of area and perimeter

III. Volume
     A. Defining Volume
     B. Prisms and Cylinders
        • product formulae; right vs. oblique cylinders; pyramids and cones
     C. Behavior under Scaling and Change of Units
        • proportionality to the cube; three-dimensionality; independence of volume and surface area

IV. Angle
    A. Defining and Measuring Angles
       • using a protractor; alignment and orientation; units of angle
    B. Summing Angles
       • adding adjacent angles; summing angles of a triangle; summing interior angles of a polygon
    C. Behavior under Scaling and Change of Units
       • zero-dimensionality; independence of angle from linear measure of subtended chord; similarity;
         applications

V. Euclidean Geometry
   A. Axiomatic Reasoning
      • Euclid’s axioms; rigidity; proofs of some simple facts; motivation for euclidean rigor
   B. Constructions with Straightedge and Compass
      • relation to the axioms; basic constructions; proving your construction works
   C. New Proofs of Old Formulas
      • rigorizing proof of area formulae; pythagorean theorem

VI. Symmetry and Rigid Motion
    A. Rigid Motions
       • reflections, rotations, translations; composing rigid motions
    B. Symmetry of Plane Figures
       • reflections and lines of symmetry; rotations and centers of symmetry; finding all symmetries
    C. Tesselations and Their Symmetries
       • translation symmetry; wallpaper patterns; classification of regular/semi-regular tesselations
    D. Three-Dimensional Shapes
       • Platonic solids; planes of reflection; axes of rotation; symmetries of regular and other polyhedras

VII. General Skills
     A. Spatial Imagination
     B. Drawing and Sketching
     C. Vocabulary
     D. Broader Context: Role of Geometric Intuition in Mathematical Concept Formation

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

Course Coordinator:
Robin Pemantle
2002-2003
Mathematics 107  
Sp  
5 cr.  
Topics in Mathematics  
For Elementary Teachers

Prerequisite:
Mathematics 106

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

Purpose of Course:
To develop an appreciation of, and basic competency in, the use of analytical thought in the development of a cohesive body of useful mathematical knowledge, with special emphasis on topics encountered in elementary and middle school mathematics programs. Math 107 deals with combinatorics, probability, functions, sequences and series, logic, compound interest, and general mathematical skills.
Topics List

I. Combinatorics
   A. Cartesian Products and Power Sets (review)
   B. Combinations and Permutations
   C. Binomial Coefficients

II. Probability
    A. Probability Spaces
    B. Independence and Conditional Probability
    C. Combinatorial Probability
    D. Law of Large Numbers

III. Functions
     A. General Functions
     B. Famous Functions

IV. Sequences and Series
    A. General Sequences
    B. Series

V. Logic
   A. Review of Propositional Logic: the converse and contrapositive
   B. Qualifiers
   C. Analysis of Arguments
   D. Classic Proofs

VI. Compound Interest
    A. What is Compound Interest?
    B. Computing

VII. General Skills
     A. Estimation and Mental Calculation
     B. Recursive Use of Notation
     C. Broader Context
Mathematics 116
*A, W, Sp, Su

(*Offered in Autumn on regional campuses only.)

Prerequisite:

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

Catalog Description:

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

Purpose of Course:

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

Follow-up Courses:

None. Math 116 is a terminal course.

Text:

Excursions in Modern Mathematics, 4 ed, Tannenbaum/Arnold

Topics List:

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

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

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

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

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

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

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

Probability
Sample spaces, counting principles, permutations and combinations, probability spaces, equally likely outcomes

Symmetry
Geometric symmetry, rigid motions, reflections, rotations, translations
Prerequisite:
Mathematics 148, 150, Course Code M, or Permission from the Math Department

Catalog Description:
An introduction to differential and integral calculus.

Purpose of Course:
The majority of the audience is made up of Architecture majors (who will have already taken 148 and 150) for whom the course is a requirement, with the balance being Early Childhood and Middle Childhood Ed. students doing a Math Concentration. The intent of the course is to provide students with basic concepts and skills associated with calculus, along with the applications of the topic.

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

Text:

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

(Over For Topics List And Sample Syllabus)
# Topics List & Sample Syllabus

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<th>Topics</th>
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<td>1.5</td>
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<td>2.1</td>
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<td>2.2</td>
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<td>2.3</td>
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<td>3.3</td>
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<tr>
<td>3.5</td>
<td>Modeling and Optimization</td>
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<tr>
<td>3.6</td>
<td>Linearization and Differentials</td>
</tr>
</tbody>
</table>

Exam I

| 4.1      | Indefinite Integrals, Differential Equations, and Modeling |
| 4.3      | Estimating with Finite Sums |
| 4.4      | Riemann sums and Definite Integrals |
| 4.5      | Fundamental Theorem of Calculus |
| 4.2      | Integral Rules: Integration by Substitution |
| 4.6      | Substitution of Definite Integrals |
| 7.5      | Integral Tables |
| 4.7      | Numerical Integration |
| 5.1      | Volumes by Slicing and Rotating about an Axis |
| 5.2      | Modeling Volume by Cylindrical Shells |
| 5.3      | Lengths of Plane Curves |
| (Supplement) | Surface Area |
| 5.5      | Springs, Pumping, and Lifting |
| 5.6      | Fluid Forces |
| 5.7      | Moments and Centers of Mass |

Exam II
Review and/or Additional Topics in Chapter 11, 12

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**To be Referred to in Appropriate Sections:**

| 11.1  | Functions of Several Variables |
| 11.3  | Partial Derivatives |
| 11.6  | Linearization and Differentials |
| 11.7  | Extreme Values and Saddle Points |
| 12.1  | Double Integrals |
| 12.2  | Areas, Moments, and Centers of Mass |
| 12.4  | Triple Integrals |
| 12.6  | Masses and Moments in Three Dimensions |

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

Course Coordinator:
Victor Ferdinand
2002-2003
Mathematics 130 4 cr. Math Analysis for Business I
A, W, Sp, Su

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

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

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

Follow-up Course:
Math 131

Text:
Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences, Haeussler & Paul, 10th ed.

Topics & Sample Syllabus

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<thead>
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<th>Sections</th>
<th>Topics</th>
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<td>Applications of Equations, Linear Equations</td>
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<tr>
<td>2.3/3.1</td>
<td>Applications of Inequalities</td>
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<td>3.2/3.4</td>
<td>Special Functions, Graphs in Rectangular Coordinates</td>
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<td>8.3/8.4</td>
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<tr>
<td>6.1/6.2</td>
<td>Matrices, Matrix Addition, and Scalar Multiplication</td>
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<td>6.3/6.4</td>
<td>Matrix Multiplication, Method of Reduction</td>
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</tbody>
</table>
Math 131  4 cr.  Mathematical Analysis for Business II  
Au 2002 only

*Curriculum changes occurred in Math 131  
and Math 132, academic year 2002-2003

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

Catalog Description:
Matrices, determinants, linear programming, interpretation of graphs, modeling, applications.

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

Text:
Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences,  
Haeussler & Paul, 10th ed.

**Topics and Sample Syllabus**

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

Course Coordinator  
Phil Huneke  
2002-2003
Math 131
W, Sp, Su 2003
4 cr.
Mathematical Analysis for Business II

*curriculum changes occurred in Math 131
and Math 132, academic year 2002-2003

Prerequisite:

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

Catalog Description:

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

Purpose of Course:

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

Text:

Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences, Haeussler & Paul, 10th ed.

Topics and Sample Syllabus

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

Course Coordinator
Phil Huneke
2002-2003
Math 132 5 cr. Mathematical Analysis for Business III
Au 2002, Wi 2003 only

*Curriculum changes occurred in Math 131
and Math 132, academic year 2002-2003

Prerequisite:
Mathematics 130 or 150

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

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

Text:
Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences,

(over for Topics List)
# Topics and Sample Syllabus for Math 132

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<td>Relative Extrema</td>
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**DEPARTMENT OF MATHEMATICS**  
**THE OHIO STATE UNIVERSITY**  
**231 WEST EIGHTEENTH AVENUE**  
**COLUMBUS, OHIO 43210-1174**

Course Coordinator:  
Surinder Sehgal  
2001-2002
Math 132  5 cr.  Mathematical Analysis for Business III
Sp, Su 2003
(revised section numbers)

*Curriculum changes occurred in Math 131
and Math 132, academic year 2002-2003

Prerequisite:
Mathematics 131 or 151

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

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

Text:
Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences,

Sections  Topics
15.2     Differentials
16.1     The Indefinite Integral
16.2     Integration with Initial Conditions
16.3     More Integration Formulas
16.4     Techniques of Integration
16.5     Summation
16.6     The Definite Integral
16.7     The Fundamental Theorem of Calculus
16.8     Area
16.9     Area Between Curves
16.10    Consumer Surplus and Producers Surplus
17.1     Integration by Parts
17.2     Integration by Partial Fractions
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19.6     Chain Rule
19.7     Maxima and Minima for Functions of Two Variables
19.8     Change

Course Coordinator:
Surinder Sehgal
2002-2003
Mathematics 140  Au  5 cr.  Calculus with Review I
Mathematics 141 Wi  5 cr.  Calculus with Review II

(no change from 2001-2002)

Prerequisite:

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

Catalog Description:

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

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

Purpose:

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

Follow-up Course:

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

Text:

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

Topics:

The two courses together cover the topics in differential calculus as listed in 151. The assignments are longer and more searching than is feasible in a standard pace course. The students, thereby reinforce their mastery of algebra, analytic geometry, and trigonometry.
Mathematics 150
A, W, Sp, Su

5 cr.

Elementary Functions

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

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

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

Follow-up Course:
Math 151 or Math 117

Text:

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

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Course Coordinator:
Paul Ponomarev
2002-2003

DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
231 WEST EIGHTEENTH AVENUE
COLUMBUS, OHIO 43210-1174
Mathematics 148
A, W, Sp, Su
4cr.
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 OSU Custom Edition (2002 – 2003), Hungerford

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

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

Course Coordinator:
David George
2002-2003
Mathematics 151  5 cr.  Calculus and Analytic Geometry  
A, W, Sp, Su  

Prerequisite:  
Mathematics 150 or Course Code L on Math Placement Test.  

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

Purpose of Course:  
To provide students with a solid foundation in one-variable differential calculus.  

Follow-up Course:  
Math 152  

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

Topics & Sample Syllabus:  

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

Course Coordinator: Zbigniew Fiedorowicz  
2002-2003
Mathematics 152
A, W, Sp, Su

5 cr.

Calculus and Analytic Geometry

Prerequisite:
Mathematics 151

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

Purpose of Course:
To provide students with a solid foundation in one-variable integral calculus.

Follow-up Course:
Math 153

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

(Over for Topics List & Sample Syllabus)
### Topics List & Sample Syllabus

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<th>Topics</th>
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**Review and Final Exam**
Mathematics 153 5 cr. Calculus and Analytic Geometry

Prerequisite:
Mathematics 152

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

Purpose of Course:
To provide students with a solid foundation in calculus.

Follow-up Course:
Math 254

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

Topics & Sample Syllabus

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Course Coordinator:
Phil Huneke
2002-2003
Mathematics 188 1 cr.  Invitation to Actuarial Science
Sp

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

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

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

Text:
A textbook is not used in this course.

Syllabus:
WEEK 1  Introduction to Actuarial Science. Discussion of the Major Program in Actuarial Science at Ohio State. Opportunities and expectations for careers in actuarial science and related areas.

WEEKS 2-9  Visits by practicing actuaries from local firms who will give overviews of various aspects of the profession; and talks by O.S.U. faculty from mathematics and related fields, such as statistics, risk management, finance, and economics.

WEEK 10  Course summary, student feedback, and discussions.

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

Course Coordinator:
Bostwick Wyman
2002-2003
Mathematics 254  5 cr.  Calculus and Analytic Geometry

Prerequisite:
Mathematics 153

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

Purpose of Course:
To provide students with a solid foundation in calculus.

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

**Topics & Sample Syllabus**

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Course Coordinator:
Phil Huneke
2002-2003
Mathematics
151A Au 5 cr. each  Calculus and Analytic Geometry
152A Wi
153A Sp
254A Au

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

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

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

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

Text:

Topics:
151A: Chapters 1, 2, 3, and 4. Topics include exponential, logarithmic, and trigonometric functions, and the concept, computations, and applications of derivatives.

152A: Chapters 5, 6, 7, and 8. Topics include antiderivatives, and the concept, computations, and applications of integration.

153A: Chapters 9, 10, 12, 13, appendices B and C, and part of Chapter 17 if time. Topics include approximations and series, functions of several variables, vectors, polar coordinates, and complex numbers.

254A: Chapters 13, 15-20. Topics include differentiation and integration of functions of several variables; vector fields; line integrals; and calculus of vector fields.

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

Course Coordinator:
Alice Yew
2002-2003
Mathematics 151C  Au, Wi  5 cr. each  Calculus and Analytic Geometry
Mathematics 152C  Wi, Sp
Mathematics 153C  Sp, Au
Mathematics 254C  Au, Wi

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

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

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

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

Text:

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

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For further information see:
Tony Nance
2002-2003
Mathematics 161  Au  5 cr. each  Accelerated Calculus with Analytic Geometry
Mathematics 162  Wi
Mathematics 263  Sp

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

Catalog Descriptions:

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

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

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

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

Follow-up Course:
Courses in differential equations or linear algebra, possibly H520.

Text:

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

Topics:

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

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

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

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Course Coordinator:
Henry Glover
2002-2003
(no change from 2001-2002)
Math 161 G  Au  5 cr.  Accelerated Calculus with Analytic Geometry I, II, III
Math 162 G  Wi
Math 263 G  Sp

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

Catalog Description:

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

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

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

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

Text:
Calculus with Analytic Geometry, (5th ed.), R. Ellis and D. Gulick.

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

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(no change from 2001-2002)

Course Coordinator: Nela Lakos
2002-2003
Prerequisite:

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

Catalog Description:

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

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

Purpose of Course:

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

Follow-up Course:

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

Text:

Calculus with Analytic Geometry, Simmons

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

Topics:

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

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

H263-Vectors, parametric equations, surfaces, cylindrical and spherical coordinates, partial derivatives, multiple integrals, line integrals, vector fields, Green's theorem, Divergence theorem, Stokes' theorem.
Mathematics  H190  Au  5 cr.  Elementary Analysis I
H191  Wi
H264  Sp  Elementary Analysis II
       Elementary Analysis III

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

Catalog Descriptions:

H190:  Special course for superior students.

H191:  Continuation of H190.

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

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

Follow-up Sequence:
Math H520, H521, H522

Texts:

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

Topics:


H264:  Multivariable calculus (vector approach), gradients, multiple integrals, line and surface integrals, Green's Theorem, divergence theorem, Stokes' Theorem.
Mathematics 255  Au, Wi, Sp, Su  5 cr.  Differential Equations and Their Applications
Mathematics 255C Au, Wi, Sp

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

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

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

Text:
Differential Equations & Mathematica, Davis (255C)

Topics & Sample Syllabus

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DEPARTMENT OF MATHEMATICS
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231 WEST EIGHTEENTH AVENUE
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Topics & Sample Syllabus, cont’d

Higher Order Linear Differential Equations 3 lectures

6.1 Basic Theory of Linear Differential Equations
6.2 Homogeneous Linear Equations with Constant Coefficients
6.3 Undetermined Coefficients and the Annihilator Method

Series Solutions of Differential Equations 6 lectures

8.1 Taylor Polynomial Approximation
8.2 Power Series and Analytic Functions
8.3 Power Series Solutions to Linear Differential Equations
8.4 Equations with Analytic Coefficients
8.5 Cauchy-Euler Equations Revisited
8.6 Method of Frobenius
8.7 Finding a Second Linearly Independent Solution
8.8 Special Functions

Midterm II

Laplace Transforms 5 lectures

7.1 Introduction: A Mixing Problem
7.2 Definition of the Laplace Transform
7.3 Properties of the Laplace Transform
7.4 Inverse Laplace Transform
7.5 Solving Initial Value Problems
7.6 Transform of Discontinuous and Periodic Functions
7.7 Convolution
7.8 Impulses and the Dirac Delta Function
7.9 Solving Linear Systems with Laplace Transforms
Mathematics 345  
4 cr.  
Foundations of Higher Mathematics

Prerequisite:
Mathematics 254.

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

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

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

Text:
The Fundamentals of Higher Mathematics, Falkner

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

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Course Coordinator:  
Neil Falkner  
2002-2003
Mathematics 366
A, W, Sp, Su (1st Term)

3 cr.

Discrete Mathematical Structures I

Prerequisite:
Mathematics 132 or 152.

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

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

Follow-up Course:
Math 566.

Text:

(Over for Topics List)
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Course Coordinator:
Timothy Carlson
2001-2002
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Mathematics 414 3 cr. Group Studies: Differential Equations for Engineering Applications

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

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

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

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

Texts:

(Over for Topics List & Sample Syllabus)
Topics List & Sample Syllabus:

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

DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
231 WEST EIGHTEENTH AVENUE
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(no change from 2001-2002 syllabus)

Course Coordinator:
George Majda
2002-2003
Prerequisite:
Mathematics 254

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

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

Text:
Elementary Differential Equations and Boundary Value Problems, 7th edition, Boyce and DiPrima. (415)

Differential Equations & Mathematica, Davis (415C)

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

Course Coordinator:
George Majda
2002-2003
Prerequisite:
Permission of Department.

Catalog Description:
An advanced enrichment course for interested and capable students.

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

Topics:
Interesting special problems as chosen by the instructor.
Mathematics 504 5 cr. History of Mathematics
Sp, Su

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

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

Purpose of Course:
This course is an introduction to the history of mathematics. The course now has a two-fold purpose:
(i) Expose the students to the good mathematics of yesteryear (while placing the evolution of mathematics in a historical setting);
(ii) This course fulfills the spirit of the Third-Level Writing Course for math majors. Oral presentations, short essays, and a long final paper may be required.

Texts:
Texts used in the past include:

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

Topics:
The topics will vary based on the instructors.
Mathematics 507 A, W  5 cr. Advanced Geometry

Prerequisite:
Mathematics 345 or GRAD standing

Catalog Description:
Advanced topics from Euclidean Geometry.

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

Text:

Optional Reference:
Clemens & Clemens, Geometry for the Classroom, Springer Verlag.

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

Course Coordinator:
Herb Clemens
2002-2003
Mathematics 512  
A, W, Sp, Su (1st Term)  

3 cr.  
Partial Differential Equations and Boundary Value Problems

Prerequisite:
Mathematics 255 or 415 or 556.

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

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

Text:

### Topics List & Sample Syllabus

<table>
<thead>
<tr>
<th>Sections</th>
<th>Topics</th>
<th>Approximate Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.1-10.4</td>
<td>Fourier Series</td>
<td>8 days*</td>
</tr>
<tr>
<td>10.6</td>
<td>Forced Oscillations</td>
<td></td>
</tr>
<tr>
<td>10.7 (optional)</td>
<td>Approximation by trigonometric polynomials</td>
<td></td>
</tr>
<tr>
<td>11.1, 11.3-11.5</td>
<td>Partial Differential Equations**</td>
<td>8 days*</td>
</tr>
<tr>
<td>11.8 (optional)</td>
<td>Rectangular Membrane: Use of Double Fourier Series</td>
<td></td>
</tr>
<tr>
<td>11.9 (optional)</td>
<td>Laplacian in Polar Coordinates</td>
<td></td>
</tr>
<tr>
<td>5.1-5.8</td>
<td>Laplace Transform</td>
<td>9 days*</td>
</tr>
<tr>
<td>If time permits:</td>
<td>Application of Laplace Transform to PDE’s (or other applications)</td>
<td>3 days</td>
</tr>
</tbody>
</table>

*Including a test

**Only rectangular coordinates are required. The Kreyszig is a bit skimpy in the variety of examples and contexts in which separation of variables is used, especially with regard to Laplace's equation. It should be considerably augmented with examples from other texts.

(no change from 2001-2002 syllabus)

Course Coordinator:
George Majda
2002-2003

DEPARTMENT OF MATHEMATICS  
THE OHIO STATE UNIVERSITY  
231 WEST EIGHTEENTH AVENUE  
COLUMBUS, OHIO 43210-1174
Prerequisite:
Mathematics 254

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

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

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

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

Topics & Sample Syllabus

<table>
<thead>
<tr>
<th>Sections</th>
<th>Topics</th>
<th>Approximate Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1-1.12, 1.14</td>
<td>Review vector algebra, geometry, Dot and cross products, lines and planes</td>
<td>4 days</td>
</tr>
<tr>
<td>2.1-2.3</td>
<td>Vector functions of one variable, arc length, Velocity, acceleration, curvature</td>
<td>5 days</td>
</tr>
<tr>
<td>(2.4 optional)</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1, 3.3-3.6</td>
<td>Vector and scalar functions, Chain Rule, Divergence, gradient and curl, directional derivative, normals, tangent planes</td>
<td>4 days</td>
</tr>
<tr>
<td>4.1-4.4, 4.8-4.12, 4.15, 4.16</td>
<td>Line integrals, potentials, surfaces, surface integrals, Green’s Theorem, the Divergence Theorem, Stoke’s Theorem, potentials, Applications</td>
<td>13 days</td>
</tr>
</tbody>
</table>

This syllabus is based on the Davis and Snider text. This book is well-written but very verbose. It does not include any applied science applications from fluid mechanics or electricity and magnetism, for example.

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

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

Course Coordinator:
George Majda
2002-2003

DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
231 WEST EIGHTH AVENUE
COLUMBUS, OHIO 43210-1174
Mathematics 514 3 cr. 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, Churchill, 5th edition (used Sp 93, Sp 94, Sp 95)

Possible Alternative Text:
Advanced Engineering Math, Kreyszig, 8th edition

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

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

Sample Syllabus #1 Based on Churchill:

<table>
<thead>
<tr>
<th>Topics</th>
<th>Approximate Time (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complex numbers, polar form</td>
<td>3</td>
</tr>
<tr>
<td>Analyticity, Cauchy-Riemann equations</td>
<td>3</td>
</tr>
<tr>
<td>Elementary functions</td>
<td>4</td>
</tr>
<tr>
<td>Mapping by elementary functions</td>
<td>TEST</td>
</tr>
<tr>
<td>Cauchy integral theorem and consequences</td>
<td>5</td>
</tr>
<tr>
<td>Power series</td>
<td>TEST</td>
</tr>
<tr>
<td>Residues, definite integrals</td>
<td>3</td>
</tr>
</tbody>
</table>

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

<table>
<thead>
<tr>
<th>Topics</th>
<th>Approximate Time (days)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Complex analytic functions</td>
<td>9</td>
</tr>
<tr>
<td>Complex integrals</td>
<td>5</td>
</tr>
<tr>
<td>Power Series, Taylor and Laurent Series</td>
<td>4</td>
</tr>
<tr>
<td>Integration by residues</td>
<td>6</td>
</tr>
<tr>
<td>Conformal Mapping (omit 16.5)</td>
<td></td>
</tr>
<tr>
<td>Complex functions and potential theory: (if time permits and prior material is grasped)</td>
<td></td>
</tr>
</tbody>
</table>

(no change from 2001-2002 syllabus)

Course Coordinator:
George Majda
2002-2003
Mathematics  H520  Au  5 cr. each  Linear Algebra  Differential Equations  Complex Analysis
H521  Wi
H522  Sp

Prerequisites:

H520-H263 or H264 with a grade of C or better, or written permission of Honors Committee chairperson.

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

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

Catalog Descriptions:


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

H522: Analytic functions, Cauchy integral theory, residue calculus, series representations, conformal mapping.

Purpose of Course:

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

Texts  vary, for example:

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

Course Coordinator:
V. Bergelson
2002-2003
Mathematics 530  
3 cr.  
Probability

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

Catalog Description:
Combinatorial probability, random variables, independence, expectations, variance, limit theorems.

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

Text:
Probability, Jim Pitman.

Topics:
Sets  
Probability  
Counting  
Random Variables  
Independence and conditioning  
Mean, variance  
Limit theorems
Mathematics 532  3 cr.  Mathematical Foundations of Actuarial Science

Prerequisite:
Mathematics 530 or Statistics 520, or permission of instructor.

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

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

Text:
Actex One-Pack, review manual for Exam 1.

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(no change from 2001-2002 syllabus)

Course Coordinator:
Bostwick Wyman
2002-2003
Mathematics H540 5 cr. Geometry and Calculus in Euclidean Spaces and on Manifolds I

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

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

Catalog Description
The topology of $\mathbb{E}^n$, differentiation of vector valued functions, inverse and implicit function theorems, Riemann and Lesbegue integration in $\mathbb{E}^n$.

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

Follow-up course
Math H541.

Text
Differential Geometry of Curves and Surfaces, Docarmo, (or similar level text)

Topics
Introduction to convex sets in $\mathbb{E}^n$, some point set topology in $\mathbb{E}^n$, (including compactness and connectedness properties of subsets of $\mathbb{E}^n$), differentiation of vector valued functions of several variables, relative extrema, the inverse and implicit function theorems, and an introduction to Lebesgue integration in $\mathbb{E}^n$.
Mathematics H541 5 cr.  Geometry and Calculus in Euclidean Spaces and on Manifolds II

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

Prerequisite

Mathematics H540, or permission of the instructor

Catalog Description

Curves and line integrals in \( \mathbb{E}^n \), tensor and exterior algebras, differential forms, integration on manifolds, divergence and Stokes' theorem and applications.

Purpose of Course

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

Text

Differential Geometry of Curves and Surfaces, Docarmo, (or similar text)

Topics

Review and completion of the discussion of Lebesgue integration in \( \mathbb{E}^n \), coverage of change of variables theorems in \( \mathbb{E}^n \), differentiation of parametrized integrals, curves in \( \mathbb{E}^n \), differential 1-forms, line integrals, the exterior algebra and differential calculus in \( \mathbb{E}^n \), differential forms and tensor algebra, integration on manifolds, the divergence theorem, and Stokes' theorem.
Mathematics 547 3 cr. Introductory Analysis I

A, W

Prerequisite:

Mathematics 345 or equivalent

Catalog Description:

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

Purpose of Course:

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

Follow-up Course:

Math 548.

Text:

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

Topics:


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 or 551 or 552.

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

Topics:
2. Power series.
3. Continuous functions.
4. Limits of functions.
5. Uniform continuity.
7. Mean-Value Theorem.
8. L'Hospital's Rules.
Mathematics 549  3 cr.  Introductory Analysis III
Au,Sp

Prerequisite:
Mathematics 548.

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

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

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

Topics:
1. Taylor's Theorem.
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.
Mathematics 551  5 cr.  Vector Analysis

Prerequisite:
Mathematics 254

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

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

Text:
Vector Calculus, Thomas H. Barr

Other References:
Advanced Calculus, 2nd ed., Wilfred Kaplan. (With supporting problems from Schaum's.)

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

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

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

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

Course Coordinator:
Luis Casian
2002-2003

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(no change from 2001-2002 syllabus)
Mathematics 552  5 cr.  Introduction to the Theory of Functions of a Complex Variable

Prerequisite:
Mathematics 254

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

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

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

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

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

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(no change from 2001-2002 syllabus)

Course Coordinator:
Luis Casian
2002-2003
Mathematics 566
A, W, Sp, Su (2nd Term)

Prerequisite:
Mathematics 366.

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

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

Text:

Topics and Sample Syllabus

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<th>Sections</th>
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<td>COUNTING</td>
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<tr>
<td>6.2</td>
<td>The Growth of Functions</td>
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<tr>
<td>6.3</td>
<td>Possibility Trees and the Multiplication Rule</td>
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<tr>
<td>6.4</td>
<td>Counting Elements of Disjoint Sets: The Addition Rule</td>
</tr>
<tr>
<td>6.5</td>
<td>Counting Subsets of a Set: Combination</td>
</tr>
<tr>
<td>6.6</td>
<td>R-Combinations with Repetition Allowed</td>
</tr>
<tr>
<td>6.7</td>
<td>The Binomial Theorem</td>
</tr>
<tr>
<td>8.1</td>
<td>RECURSION</td>
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<td>8.2</td>
<td>Recursively Defined Sequences</td>
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<tr>
<td>8.3</td>
<td>Solving Recurrence Relations by Iteration</td>
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<tr>
<td>8.4</td>
<td>Second-Order Homogeneous Recurrence Relations with Constant Coefficients</td>
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<tr>
<td>9.1</td>
<td>General Recursive Definitions</td>
</tr>
<tr>
<td>9.2</td>
<td>O-NOTATION AND THE EFFICIENCY OF ALGORITHMS</td>
</tr>
<tr>
<td>11.1</td>
<td>Real-Valued Functions of a Real Variable and Their Graphs</td>
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<tr>
<td>11.2</td>
<td>O-Notation</td>
</tr>
<tr>
<td>11.3</td>
<td>GRAPHS AND TREES</td>
</tr>
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<td>11.4</td>
<td>Graphs: An Introduction</td>
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<tr>
<td>11.5</td>
<td>Paths and Circuits</td>
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<tr>
<td>11.6</td>
<td>Matrix Representation of Graphs</td>
</tr>
<tr>
<td>11.7</td>
<td>Isomorphisms of Graphs</td>
</tr>
<tr>
<td>11.8</td>
<td>Trees</td>
</tr>
<tr>
<td>11.9</td>
<td>Spanning Trees</td>
</tr>
</tbody>
</table>

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

Course Coordinator
Timothy Carlson
2002-2003
Mathematics 568
A, W, Sp, Su (1st Term)

3 cr. Introductory Linear Algebra I

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

Catalog Description:
The space $\mathbb{R}^n$ and its subspaces; matrices as mappings; matrix algebra; systems of equations; determinants; dot product in $\mathbb{R}^n$; geometric interpretations.

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

Follow-up Course:
None.

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

Topics and Sample Syllabus

<table>
<thead>
<tr>
<th>Sections</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>Systems</td>
</tr>
<tr>
<td>1.2</td>
<td>Row Reduction</td>
</tr>
<tr>
<td>1.3</td>
<td>Vector Equations</td>
</tr>
<tr>
<td>1.4</td>
<td>The Matrix Equation</td>
</tr>
<tr>
<td>1.5</td>
<td>Solution Sets of Linear Systems</td>
</tr>
<tr>
<td>1.6</td>
<td>Linear Independence</td>
</tr>
<tr>
<td>6.1</td>
<td>ORTHOGONALITY AND LEAST-SQUARES</td>
</tr>
<tr>
<td>6.2</td>
<td>Inner Product, Length, Orthogonality</td>
</tr>
<tr>
<td>6.3</td>
<td>Orthogonal Sets</td>
</tr>
<tr>
<td>6.4</td>
<td>Orthogonal Projections</td>
</tr>
<tr>
<td>6.5</td>
<td>The Gram-Schmidt Process</td>
</tr>
<tr>
<td>1.7</td>
<td>LINEAR EQUATIONS IN LINEAR ALGEBRA</td>
</tr>
<tr>
<td>1.8</td>
<td>Introduction to Linear Transformations</td>
</tr>
<tr>
<td>2.1</td>
<td>MATRIX ALGEBRA</td>
</tr>
<tr>
<td>2.2</td>
<td>Matrix Operations</td>
</tr>
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<td>2.3</td>
<td>Inverses</td>
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<tr>
<td>5.1</td>
<td>Invertible Matrices</td>
</tr>
<tr>
<td>5.2</td>
<td>EIGENVALUES AND EIGENVECTORS</td>
</tr>
<tr>
<td>5.3</td>
<td>Eigenvectors</td>
</tr>
<tr>
<td>5.4</td>
<td>Characteristic Equation</td>
</tr>
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<td>5.5</td>
<td>Diagonalization</td>
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<td>5.6</td>
<td>Linear Transformations</td>
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<table>
<thead>
<tr>
<th>Sections</th>
<th>Topics</th>
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<td>4.4</td>
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<td>4.5</td>
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<td>Rank</td>
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<td>3.1-3.2</td>
<td>Change of Basis</td>
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<td>3.3</td>
<td>DETERMINANTS</td>
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<td>3.4</td>
<td>Properties of Determinants</td>
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<tr>
<td>3.5</td>
<td>Cramer’s Rule</td>
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</tbody>
</table>

Course Coordinator
Harry Allen
2002-2003
Mathematics 571 3 cr. Linear Algebra for Applications I

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

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

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

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

Leon:

<table>
<thead>
<tr>
<th>Sections</th>
<th>Topics</th>
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<tbody>
<tr>
<td>Chapter 1</td>
<td>Matrices and Systems of Equations</td>
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<td>Chapter 2</td>
<td>Determinants</td>
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<td>Chapter 3</td>
<td>Vector Spaces</td>
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<td>Chapter 5 (5.1-5.4)</td>
<td>Orthogonality</td>
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(no change from 2001-2002 syllabus).

Course Coordinator: Ed Overman
2002-2003
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, 2nd edition
Linear Algebra with Applications, S. Leon, 5th edition

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

<table>
<thead>
<tr>
<th>Leon: Sections</th>
<th>Topics</th>
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<tr>
<td>Chapter 5</td>
<td>Orthonormal Sets (Sections 5.5-end of chapter)</td>
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<tr>
<td>Chapter 4</td>
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<tr>
<td>Chapter 6</td>
<td>Eigenvalues</td>
</tr>
</tbody>
</table>

(no change from 2001-2002 syllabus)

Course Coordinator:
Ed Overman
2002-2003
Mathematics 573
Sp of odd numbered years

5 cr.

Elementary Number Theory

Prerequisite:
Mathematics 153

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

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

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

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

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(no change from 2001-2002 syllabus)

Course Coordinator:
Paul Ponomarev
2002-2003
Mathematics 575
Wi, Sp

5 cr.
Combinatorial Mathematics and Graph Theory

Prerequisite:
Mathematics 568.

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

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

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

Text:
Introductory Combinatorics, (3rd 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, orthonality of latin squares, finite projective planes, block designs, symmetric block designs, Hadamard matrices.

(Of for Topics List)
Topics List

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

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

The Binomial Coefficients
Pascal’s formula, the binomial theorem, identities, the multinomial theorem, Newton’s binomial theorem

Matchings in Bipartite Graphs
General problem formulation, matchings, systems of distinct representatives

Introduction to Graph Theory
Basic properties, Eulerian trails, Hamilton chains and cycles, bipartite multigraphs, trees

More on Graph Theory
Chromatic number, plane and planar graphs, 5-color theorem

Recurrence Relations & Generating Functions
Some number sequences, linear homogeneous recurrence relations, non-homogeneous recurrence relations, generating functions, recurrences and generating functions, exponential generating functions

Special Counting Sequences
Difference sequences and Stirling numbers, partition numbers

Combinatorial Designs
Block designs, steiner triple system, latin squares
Mathematics  H576  Wi*  5 cr. each  Number Theory  
H577  Sp*  Through History I, II

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

Prerequisite:

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

Catalog Description:

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

H577:  Continuation of H576.

Purpose of Course:

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

Texts:

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

(over for Suggested Topics List)
Suggested Topics List

H576:


2. Famous irrationalities.

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


H577:


3. Quadratic reciprocity.


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

Prerequisite:
CIS 221, and Mathematics 568, and either Mathematics 530 or Statistics 427.

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

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

Text:
Discrete Dynamical Systems, Sandefur

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

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

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

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

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Course Coordinator:
D. Ray-Chaudhuri
2002-2003
Mathematics 580 Au, Wi 3 cr. each Algebra I
581 Wi, Sp 582 Sp, Au Algebra II
Algebra III

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

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

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

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

Text:
Notes by R. Solomon

Topics:

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

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

Mathematics 588 4 cr.  Practicum in Actuarial Science

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

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

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

Text:
There is no text for this course.

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

Course Coordinator:
Bostwick Wyman
2002-2003
Mathematics H590 Au 5 cr. each Algebraic Structures I
H591 Wi Algebraic Structures II
H592 Sp Algebraic Structures III

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

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

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

Suggested Topics :

H590:
1. Integers, unique factorization; congruences, Euler function.
2. Groups, subgroups, homomorphisms and isomorphisms, normal subgroups, quotient groups,
permutation groups, cyclic groups, Cauchy Theorems, Sylow's Theorems; direct products,
fundamental theorem for finite Abelian group; G-sets.
3. Rings, subrings, ideals, morphisms, polynomial rings, prime and maximal ideals.

H591:
1. Commutative rings, factorization theory, Euclidean rings, principal ideal rings, unique
factorization domains, Gauss' lemma; illustrations in the integers of quadratic number fields.
2. Modules over commutative rings, submodules, quotients and direct sums; fundamental theorem
for modules over principal ideal domains.
3. Vector spaces (as a special case of modules); linear maps and matrices, canonical forms, dual
spaces.
4. The theory of determinants.

H592:
1. Bilinear and quadratic forms; inner product and unitary spaces; principal axis theorem.
2. Fields, algebraic and transcendental (extensions), existence of closure (over countable fields),
tests for polynomial irreducibility; normality, separability, field automorphisms.
3. Galois theory, the subgroup-subfield correspondence theorem, group theory interrelations;
extensions of finite fields, cyclotomic extensions.
4. Solvable groups and solvability by radicals.
Mathematics 601 3 cr. Mathematical Principles in Science I

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

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

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

Follow-up Course:
Math 602

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

(Over for Topics List)
Topics List

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

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

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

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

(* 1 day = one 48 min. lecture)
Mathematics 602 3 cr.

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

Possible Texts and Topics:
I. Eigenvalues and eigenvectors:
   Linear Algebra and its Applications, Strang, (Ch. 5, 6, and Appendix A)

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

(over for Topics List)
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)
Prerequisite:
Some complex analysis. Mathematics 514 would be sufficient.

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

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

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

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

(over for Topics List)
Topics List

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

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

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

(*1 day = one 48 min. lecture)
Mathematics 618 3 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.

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

Text:

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.
5. Valuation of securities.
7. Depreciation, depletion, capitalized cost.
Prerequisite:
Mathematics 618, and Mathematics 530 or Statistics 520 or equivalent; or permission of instructor.

Catalog Description:
630: Individual risk models; survival distributions and life tables; life insurance annuities
631: Continuation of 630; net premiums and net premium reserves; multiple life functions; multiple decrement models.
632: The Mathematics 632 syllabus will be revised to match the topics in Examinations 3 and 4.

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

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

Prerequisite:
Permission of Department.

Catalog Description:

651: Real numbers, infinite sequences and series.

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

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

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

Follow-up Courses:
Math 722: Theory of Probability I
Math 750: Real Analysis I
Math 767: Introduction to the Theory of Approximation I

Possible Texts:

Introduction to Real Functions and Orthogonal Expansions, B. Sz.-Nagy,
(used 98-99, 99-00, and 00-01)
651: Chapter 1, add. mat.; 652: Chapters 2, 3, 4; 653: Chapters 5, 6 and parts of 7 & 8
[Out of print, but arrangements have been made for the text for the course.]

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

or:
An Introduction to Classical Real Analysis, K. Stromberg, (used 94-95 and 96-97);
651: Chapters 2 and 3; 652: Chapters 4, 5 and 7 (except optional sections); 653: Chapter 6
[Out of print, but may be used for reference]

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

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

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For Further Information see:
Paul Nevai
2002-2003
Mathematics 655 Au 4 cr. Each
656 Wi
657 Sp

Elementary Topology I
Elementary Topology II
Elementary Topology III

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

Catalog Descriptions:

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

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

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

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

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

Follow-up Courses:
Math 860-861-862 for algebraic topology; Math 866-867-868 for differential topology

(over for topics list and texts)

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Possible Texts:

An Introduction to Algebraic Topology, Rotman

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


Topics List for Math 655/656/657:

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

Possible Additional Topics:

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

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

DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
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Course Coordinator
Zbigniew Fiedorowicz
2002-2003
Mathematics 670 Au 5 cr. each  Algebra I
671 Wi  Algebra II
672 Sp  Algebra III

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

Catalog Descriptions:

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

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

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

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

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

Text:

Abstract Algebra, Dummit & Foote (used starting in 670, Au 95)
or
or
Topics in Algebra, Herstein.

(Over for Topics List and Sample Syllabus)
# Topics List & Sample Syllabus:

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

(This sample syllabus was based on the Artin text, as used in 1993-94. The content and the sequence will vary depending on the text and instructor.)