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</table>
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, (2nd ed.) Martin-Gay
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<td>10.5</td>
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*Review and final exam*

**Course Coordinator:**

Brian McEnnis

2000-2001
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:

\[ \begin{align*}
075 & \rightarrow 116 \\
050 & \rightarrow 130 \rightarrow 131 \\
104 & \rightarrow 148 \rightarrow 150 \rightarrow 151 \\
105 & \rightarrow 106
\end{align*} \]

Text:

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

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</table>
Mathematics 050 5 cr.  Precollege Mathematics I
A, W, Sp, Su

Prerequisite:
Course Code T on Math Placement Test.

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

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

Follow-up Course:
Math 075 or Math 104

Sequencing Chart:

105 → 106

075 → 116
050 → 130 → 131

104 → 148 → 150 → 151

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

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

<table>
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<tr>
<th>Sections</th>
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</table>
| 1.1-1.7  | REVIEW OF REAL NUMBERS  
|          | Symbols and Sets of Numbers  
|          | Fractions  
|          | Exponents and Order of Operations  
|          | Introduction to Variable Expressions and Equations  
|          | Adding Real Numbers; Subtracting Real Numbers  
|          | Multiplying and Dividing Real Numbers  |

2.1-2.9  | EQUATIONS, INEQUALITIES, AND PROBLEM SOLVING  
|          | Simplifying Algebraic Expressions  
|          | The Addition and Multiplication Property of Equality  
|          | Solving Linear Equations  
|          | An Introduction to Problem Solving  
|          | Formulas, Percent and Problem Solving  
|          | Further Problem Solving  
|          | Solving Linear Inequalities  

Review and 1st Midterm

1.9, 3.1-3.4  | GRAPHING  
|          | Reading Graphs  
|          | The Rectangular Coordinate System  
|          | Graphing Linear equations  
|          | Intercepts; Slope; Graphing Linear Inequalities  |

4.1-4.6  | EXPONENTS AND POLYNOMIALS  
|          | Exponents  
|          | Addition and Subtraction of Polynomials  
|          | Multiplication of Polynomials, Special Products  

Review and 2nd Midterm

5.1-5.7  | FACTORING POLYNOMIALS  
|          | The Greatest Common Factor and Factoring by Grouping  
|          | Factoring Trinomials  
|          | Factoring Binomials  
|          | Choosing a Factoring Strategy  

Review and 3rd Midterm

Solving Quadratic Equations by Factoring  
Quadratic Equations and Problem Solving

Review and Final Exam

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

Course Coordinator:  
Lee McEwan  
2000-2001
Mathematics 076
A, W, Sp, Su

4 cr.
Reentry Precollege Math

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:

050 → 104 → 148 → 150 → 151

075 → 116

105 → 106

Text:
Algebra, An Approach for Success, Damarin and Leitzel, (Burgess International Group, Inc.) Chapters 1 - 6, 8 - 11
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
Mathematics 103  2 cr.  Enrichment of Basic College Mathematics

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

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

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

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

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

Text:
Materials as chosen by instructor or Course Coordinator.

Topics:
Topics are chosen to supplement the students' background for material they will study in 104.
Mathematics 105  5 cr.  
A, W  
Fundamental Mathematics Concepts for Teachers I

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

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

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

Follow-up Course:
Math 106

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

Topics & Sample Syllabus:

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

Course Coordinator:
Joe Ferrar
2000-2001

DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
231 WEST EIGHTEENTH AVENUE
COLUMBUS, OHIO 43210-1174
Mathematics 106 5 cr.  Fundamental Mathematics Concepts for Teachers II

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

Catalog Description:
Continuation of 105.

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

Follow-up Course:
Math 107

Text:

and

OSU Math 106 Supplements/Labs

Topics & Sample Syllabus:

<table>
<thead>
<tr>
<th>Sections</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
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<td>6.1, 6.2, 6.3</td>
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</tr>
<tr>
<td>7.3, 11.1</td>
<td>Ratios/Probability</td>
</tr>
<tr>
<td>11.2, 11.4</td>
<td>More Probability</td>
</tr>
<tr>
<td>7.1, 7.2, 7.4</td>
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</tr>
<tr>
<td>8.1, 8.2</td>
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<td>9.1, 9.2</td>
<td>Rational and real numbers</td>
</tr>
<tr>
<td>Supp. C1-C5, 14.1</td>
<td>Deductive geometry</td>
</tr>
<tr>
<td>Supp. C6, 14.2, 14.3</td>
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</tr>
<tr>
<td>15.1, 15.2</td>
<td>Coordinate geometry</td>
</tr>
</tbody>
</table>

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

Topics:
Optional with instructor. Should closely relate to content of 105 and 106 and serve to tie together topics previously encountered. A problem-solving approach using microcomputers is highly appropriate.
Mathematics 116  
* A, W, Sp, Su  

5 cr.  

Excursions in Mathematics  

(*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:  

(Over for Topics List)
Topics List

<table>
<thead>
<tr>
<th>Chapters</th>
<th>Topics</th>
</tr>
</thead>
</table>
| Ch. 1    | Street Networks  
Finding Euler circuits  
Circuits with reused edges  
Circuits with more complications |
| Ch. 2    | Visiting Vertices  
Hamiltonian circuits  
Traveling salesman problem  
Strategies for solving the Traveling salesman problem  
Minimum cost-spanning trees  
Critical analysis |
| Ch. 4    | Linear programming  
Mixture problems  
Mixture problems having one resource  
Mixture problems having two resources  
The corner point principle  
Linear programming: The wider picture |
| Ch. 10   | Transmitting Information  
Binary codes  
Encoding with parity-check sums  
Cryptography |
| Ch. 16   | Growth and Form  
Geometric similarity  
The language of growth, enlargement, and decrease  
Measuring length, area, volume, and weight  
Scaling real objects  
Sorry, no King Kongs  
Solving the problem of scale  
Falls, dives, jumps, and flights  
Keeping cool (and warm)  
Similarity and growth |
| Ch. 17   | Symmetry and Patterns  
Fibonacci numbers  
The golden ratio  
Balance in symmetry  
Rigid motions  
Preserving the pattern  
Analyzing patterns  
Strip patterns  
Symmetry groups  
Notation for patterns  
Imperfect patterns |
Mathematics 117  
A, W, Sp  

5 cr.  
Survey of Calculus

**Prerequisite:**  
Mathematics 130 or 148 or 150

**Catalog Description:**  
An introduction to differential and integral calculus.

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

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

**Text:**  

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

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

Course Coordinator:
Surinder Sehgal
2000-2001
Prerequisite:
Mathematics 104, or Course Code M or N on Math Placement Test.

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

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

Follow-up Course:
Math 131

Text:

Topics & Sample Syllabus

<table>
<thead>
<tr>
<th>Topics</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1, 1.2</td>
<td>Linear Equations, Equations Leading to Linear Equations</td>
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<tr>
<td>1.3</td>
<td>Quadratic Equations</td>
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<tr>
<td>2.1, 2.2</td>
<td>Applications of Equations, Linear Equations</td>
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<tr>
<td>2.3</td>
<td>Applications of Inequalities</td>
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<tr>
<td>3.1, 3.2</td>
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<td>3.4</td>
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<tr>
<td>4.1, 4.2</td>
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<td>4.3</td>
<td>Quadratic Functions</td>
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<tr>
<td>4.4, 4.5</td>
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<tr>
<td>4.6</td>
<td>Applications of Systems of Equations</td>
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<tr>
<td>5.1, 5.2</td>
<td>Exponential Functions, Logarithmic Functions</td>
</tr>
<tr>
<td>5.3</td>
<td>Properties of Logarithms</td>
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<tr>
<td>5.4</td>
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<td>8.1, 8.2</td>
<td>Compound Interest, Present Value</td>
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<td>8.3, 8.4</td>
<td>Annuities, Amortization of Loans</td>
</tr>
<tr>
<td>7.1</td>
<td>Linear Inequalities in Two Variables</td>
</tr>
</tbody>
</table>

Course Coordinator
Gloria Woods
2000-2001
Math 131  
A, W, Sp, Su  

4 cr.  

Mathematical Analysis for Business II

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

Catalog Description:
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:

Topics and Sample Syllabus

<table>
<thead>
<tr>
<th>Sections</th>
<th>Topics</th>
</tr>
</thead>
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<td>6.1</td>
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<td>6.2</td>
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<tr>
<td>6.3</td>
<td>Matrix Multiplication</td>
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<td>6.4, 6.5</td>
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<td>6.6</td>
<td>Inverses</td>
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<td>6.7</td>
<td>Determinants</td>
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<tr>
<td>7.1</td>
<td>Linear Inequalities in Two Variables</td>
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<td>7.2</td>
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<td>A.7</td>
<td>Area Under a Rate-of-Change Curve</td>
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</tbody>
</table>
Math 132
Au, Wi, Sp, Su

5 cr.
Mathematical Analysis for Business III

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:

Topics & Sample Syllabus

<table>
<thead>
<tr>
<th>Sections</th>
<th>Topics</th>
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</thead>
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<tr>
<td>11.1, 11.2</td>
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<td>11.5</td>
<td>Continuity Applied to Inequalities</td>
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<td>12.1</td>
<td>Derivatives</td>
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<td>The Derivative as a rate of Change</td>
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<td>12.5</td>
<td>Product, Quotient Rules</td>
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<td>12.6</td>
<td>Power Rule</td>
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<td>13.1</td>
<td>Derivatives of Logarithmic Functions</td>
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<td>13.2</td>
<td>Derivatives of Exponential Functions</td>
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<td>Relative Extrema</td>
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<td>14.2</td>
<td>Absolute Extrema on a Closed Interval</td>
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<td>16.1</td>
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<td>16.2</td>
<td>Integration with Initial Conditions</td>
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<td>The Fundamental Theorem of Calculus</td>
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<td>16.8</td>
<td>Area</td>
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<tr>
<td>16.10</td>
<td>Consumer Surplus and Producers Surplus</td>
</tr>
<tr>
<td>17.3</td>
<td>Integration by Tables</td>
</tr>
<tr>
<td>17.5.1</td>
<td>Approximate Integration</td>
</tr>
</tbody>
</table>

Course Coordinator:
Surinder Sehgal
2000-2001
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.
Prerequisite:
Mathematics 104, or Course Code N on Math Placement Test.

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

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

Follow-up Course:
Math 150 for those students needing to take Math 151

Text:
OSU Custom Text, Dwyer and Gruenwald

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

Topics List & Sample Syllabus

<table>
<thead>
<tr>
<th>Sections</th>
<th>Topics</th>
</tr>
</thead>
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</tr>
<tr>
<td>1.2</td>
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<tr>
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<tr>
<td>2.2</td>
<td>Quadratic Equations</td>
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<tr>
<td>2.3</td>
<td>Graphs of Equations</td>
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<tr>
<td>2.5</td>
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<tr>
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<tr>
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<td>3.3</td>
<td>Trigonometric Functions of Acute Angles</td>
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<tr>
<td>3.4</td>
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<tr>
<td>3.5</td>
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<tr>
<td>3.6</td>
<td>The Law of Cosines</td>
</tr>
<tr>
<td>4.1</td>
<td>Exponential Equations</td>
</tr>
<tr>
<td>4.2</td>
<td>Using a Graphics Calculator to Solve Exponential Equations</td>
</tr>
<tr>
<td>4.3</td>
<td>Logarithms</td>
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<tr>
<td>4.4</td>
<td>Logarithmic Equations</td>
</tr>
<tr>
<td>4.5</td>
<td>Exponential Equations and Applications</td>
</tr>
</tbody>
</table>
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.

Sections | Topics
--- | ---
1.3 | Functions
1.4 | Functions: Graphs and Properties
1.5 | Functions: Graphs and Transformations
2.1 | Linear Functions
2.2 | Linear Equations and Inequalities
2.3 | Quadratic Functions
2.5 | Quadratic Equations and Inequalities
3.1 | Polynomial Functions
3.2 | Finding Rational Zeros of Polynomials
3.4 | Rational Functions
4.1 | Operations on Functions: Composition
4.2 | Inverse Functions
4.3 | Exponential Functions
4.4 | The Exponential Function with Base e
4.5 | Logarithmic Functions
4.6 | Common and Natural Logarithms
4.7 | Exponential and Logarithmic Equations
5.1 | The Wrapping Functions
5.2 | Circular Functions
5.3 | Angles and Their Measure
5.4 | Trigonometric Functions
5.5 | Solving Right Triangles
5.6 | Graphing Basic Trigonometric Functions
5.7 | Graphing \( y = k + A \sin (Bx + C) \) and ....
5.9 | Inverse Trigonometric Functions
6.1 | Basic Identities and Their Use
6.2 | Sum, Difference, and Cofunction Identities
6.3 | Double-Angle and Half-Angle Identities
6.5 | Trigonometric Equations
7.5 | Polar Coordinates and Graphs
Mathematics 151 5 cr.
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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<tr>
<td>2.2</td>
<td>Definition of a Limit</td>
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<tr>
<td>2.3</td>
<td>Limit Theorems and Continuity</td>
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<tr>
<td>2.4</td>
<td>The Squeezing Theorem and Substitution Rule</td>
</tr>
<tr>
<td>2.5</td>
<td>One-sided and Infinite Limits</td>
</tr>
<tr>
<td>2.6</td>
<td>Continuity on Intervals and the Intermediate Value Theorem</td>
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</tbody>
</table>

**Review and Midterm #1**

| 3.1      | The Derivative |
| 3.2      | Differentiable Functions |
| 3.3      | Derivatives of Combinations of Functions |
| 3.4      | The Chain Rule |
| 3.5      | Higher Derivatives |
| 3.6      | Implicit Differentiation |
| 3.7      | Related Rates |
| 3.8      | Approximations |

**Review and Midterm #2**

| 4.1      | Maximum and Minimum Values |
| 4.2      | The Mean Value Theorem |
| 4.3      | Applications of the Mean Value Theorem |
| 4.4      | Exponential Growth and Decay |
| 4.5      | the First and Second Derivative Tests |
| 4.6      | Extreme Values on an Arbitrary Interval |

**Review and Midterm #3**

| 4.7      | Concavity and Inflection Points |
| 4.8      | Limits at Infinity |
| 4.9      | Graphing |

**Review and Final Exam**

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

Course Coordinator:
Zbigniew Fiedorowicz
2000-2001
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

<table>
<thead>
<tr>
<th>Sections</th>
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<tr>
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<tr>
<td>5.2</td>
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<tr>
<td>5.3</td>
<td>Special Properties of the Definite Integral</td>
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<td>The Fundamental Theorem of Calculus</td>
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<td>5.5</td>
<td>Indefinite Integrals and Integration Rules</td>
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<tr>
<td>5.8</td>
<td>Another Look at Area</td>
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Review and Midterm #1

| 6.1 | Inverse Functions |
| 6.2 | The Natural Exponential Function |
| 6.3 | General Exponential and Logarithmic Functions |
| 6.5 | The Inverse Trigonometric Functions |
| 6.6 | L'Hôpital's Rule |
| 6.7 | Introduction to Differential Equations |
| 6.8 | Methods of Solving Differential Equations |
| 7.1 | Integration by Parts |

Review and Midterm #2

| 7.2 | Trigonometric Integrals |
| 7.3 | Trigonometric Substitutions |
| 7.4 | Partial Fractions |
| 7.5 | Integration by Tables and Symbolic Integration |
| 7.6 | The Trapezoid Rule and Simpson's Rule |
| 7.7 | Improper Integrals |
| 8.1 | Volume: The Cross-Sectional Method |
| 8.2 | Volume: The Shell Method |

Review and Midterm #3

| 8.3 | Length of a Curve |
| 8.4 | Area of a Surface |

One of the following:

| 8.5 | Work |
| 8.6 | Moments and Center of Gravity |
| 8.7 | Hydrostatic Force |

Review and Final Exam
Mathematics 153  
A, W, Sp, Su  
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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<th>Sections</th>
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Department of Mathematics  
The Ohio State University  
231 West Eighteenth Avenue  
Columbus, Ohio 43210-1174

Course Coordinator:  
Phil Huneke  
2000-2001
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
2000-2001
Mathematics 254
Au, Wi, Sp, Su
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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<td>Green's Theorem</td>
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DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
231 WEST EIGHTEENTH AVENUE
COLUMBUS, OHIO 43210-1174

Course Coordinator:
Phil Hunkele
2000-2001
Mathematics 151A  Au  5 cr. each  Calculus and
Mathematics 152A  Wi  Analytic Geometry
Mathematics 153A  Sp

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

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

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

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

Text:

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

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

153A: Chapters 9, 11, 12, 16 and appendices A and B. Topics include approximations and
series, functions of several variables, vectors, parameterized curves, polar coordinates, and complex
numbers.
Mathematics 151C  5 cr. each  Calculus and
Mathematics 152C  Analytic Geometry
Mathematics 153C
Mathematics 254C
All offered Au, Wi, Sp, Su

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

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

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

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

Text:

For 151C: Calculus & Mathematica: Derivatives
For 152C: Calculus & Mathematica: Integrals
For 153C: Calculus & Mathematica: Approximations
For 254C: Calculus & Mathematica: Vector Calculus
Mathematics 161  Au  5 cr. each  Accelerated Calculus
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.
Math 161G  Au  5 cr.  Accelerated Calculus with
Math 162 G  Wi  Analytic Geometry I, II, III
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---161 or written permission of department.
Math 263G---162 or written permission of department.

Catalog Description:

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

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

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

Purpose:

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

Text:

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

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

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

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

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

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

Text:
Calculus with Analytic Geometry, Simmons

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

Topics:

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

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

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

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

Catalog Descriptions:

H190: 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.

Course Coordinator:
V. Bergelson (Honors)
2000-2001
Mathematics 255  
A, W, Sp, Su  

5 cr.  
Differential Equations and Their Applications

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

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

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

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

Topics & Sample Syllabus

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<thead>
<tr>
<th>Sections</th>
<th>Topics</th>
<th>Approximate Time</th>
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<tr>
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<td>1-2 weeks</td>
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<td>3.1-3.7</td>
<td>Second Order Linear Equations</td>
<td>1-2 weeks</td>
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<td>4.1-4.3</td>
<td>Higher Order Linear Equations</td>
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<td>5.1-5.8</td>
<td>Series Solutions of Second Order Linear Equations</td>
<td>2 weeks</td>
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<tr>
<td>6.1-6.5</td>
<td>The Laplace Transform</td>
<td>2 weeks</td>
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Review and additional topics can be added as time permits.
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:

Course Coordinator:
Neil Falkner
2000-2001
Mathematics 366 3 cr.
A, W, Sp, Su (1st Term)

Prerequisite:
Mathematics 132 or 152.

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

Purpose of Course:
To provide the foundation for a deeper understanding of the conceptual tools in computer science. Computers, however, are not used in this course. The desire of the 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)
### Topics List & Sample Syllabus:

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<td>5.2</td>
<td>Properties of Sets</td>
</tr>
<tr>
<td>5.3</td>
<td>The Empty Set, Partitions, Power Sets, and Boolean Algebras</td>
</tr>
<tr>
<td></td>
<td>FUNCTIONS</td>
</tr>
<tr>
<td>7.1</td>
<td>Functions Defined on General Sets</td>
</tr>
<tr>
<td>7.3</td>
<td>One-to-One and Onto, Inverse Functions</td>
</tr>
<tr>
<td>7.5</td>
<td>Composition of Functions</td>
</tr>
<tr>
<td></td>
<td>RELATIONS</td>
</tr>
<tr>
<td>10.1</td>
<td>Relations on Sets</td>
</tr>
<tr>
<td>10.2</td>
<td>Reflexivity, Symmetry, and Transitivity</td>
</tr>
<tr>
<td>10.3</td>
<td>Equivalence Relations</td>
</tr>
<tr>
<td>10.5</td>
<td>Partial Order Relations</td>
</tr>
</tbody>
</table>

Further topics if time permits:

|          | RECURSION |
|          | Recursively Defined Sequences |
|          | Solving Recurrence Relations by Iteration |
|          | General Recursive Definitions |
|          | COUNTING |
|          | Counting and Probability |
|          | Possibility Trees and the Multiplication Rule |
|          | Counting Elements of Disjoint Sets: The Addition Rule |
|          | Counting Subsets of a Set: Combinations |
Mathematics 414 3 cr.  Group Studies: 
SP Differential Equations for 
Engineering Applications

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

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

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

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

Texts:


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

<table>
<thead>
<tr>
<th>Sections</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1, 2.5, 2.7</td>
<td>Introduction to Differential Equations and some Applications: Cooling, Compound Interest, Mixing, and/or Mechanics.</td>
</tr>
<tr>
<td>2.1, 2.2</td>
<td>Linear First Order ODE's and Integrating Factors</td>
</tr>
<tr>
<td>2.5</td>
<td>Applications from Lecture 1 revisited</td>
</tr>
<tr>
<td>2.7, 2.3</td>
<td>Applications: Mechanics: Separable Equations</td>
</tr>
<tr>
<td>2.3, 2.4, 2.2</td>
<td>Differences Between Linear and Nonlinear Equations, Bernoulli's Equation</td>
</tr>
<tr>
<td>2.8</td>
<td>Exact equations</td>
</tr>
<tr>
<td>2.6</td>
<td>Qualitative Properties of solutions--Equilibrium solutions, Stability, sketch of solutions, apply to chemical kinetics</td>
</tr>
<tr>
<td>3.8, 3.1</td>
<td>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</td>
</tr>
<tr>
<td>3.2, 3.3</td>
<td>Fundamental Solutions, Linear Independence, Wronskian</td>
</tr>
<tr>
<td>3.4, 3.5</td>
<td>Review Properties of Complex Numbers (Handout), Complex Roots, and Repeated Roots of the Characteristic Equation</td>
</tr>
<tr>
<td>5.5</td>
<td>Euler's Equation</td>
</tr>
<tr>
<td>3.6</td>
<td>Nonhomogeneous Equations: Method of Undetermined Coefficients</td>
</tr>
<tr>
<td>3.7</td>
<td>Nonhomogeneous Equations: Variation of Parameters</td>
</tr>
<tr>
<td>5.1</td>
<td>Review of Power Series</td>
</tr>
<tr>
<td>5.2</td>
<td>Examples of Series Solutions near an Ordinary Point</td>
</tr>
<tr>
<td>5.4, 5.6-5.8</td>
<td>Regular Singular Points, Frobenius Method, Bessel's Equation</td>
</tr>
<tr>
<td>10.2-10.4</td>
<td>Fourier Series, Convergence of Fourier Series, Even and Odd Functions</td>
</tr>
<tr>
<td>10.6</td>
<td>The Wave Equation--Derivation, Solution and Applications</td>
</tr>
<tr>
<td>6.1-6.3,6.6</td>
<td>Laplace Transform, Solution of Ordinary Differential Equations, Shifting Theorems, Convolution</td>
</tr>
</tbody>
</table>
Mathematics 415  4 cr.  Ordinary and Partial Differential Equations

Prerequisite:
Mathematics 254

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

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

Text:

Topics & Sample Syllabus

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

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

Course Coordinator: George Majda
2000-2001
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  5 cr.  Advanced Geometry
A, W

Prerequisite:
Mathematics 345 or GRAD standing

Catalog Description:
Advanced topics from Euclidean Geometry.

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

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

Topics:
I. Development of the axiom system underlying Euclidean geometry.
II. Investigation of the Euclidean and Hyperbolic parallel axioms.
III. Models of Hyperbolic Geometry
Mathematics 510.01 2-5 cr.  
510.02  
510.03  

Topics in Mathematics for Elementary School Teachers  

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

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

Prerequisite:  
One year teaching experience or permission of instructor.  

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

Topics:  
510.01: Geometry  
510.02: Properties of Numbers  
510.03: Numerical Methods  

Audience  
Designed for in-service teachers.
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:**
Advanced Engineering Mathematics, 8th ed., Kreyszig

**Topics List & Sample Syllabus**

<table>
<thead>
<tr>
<th>Sections</th>
<th>Topics</th>
<th>Approximate Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>10.1-10.5</td>
<td>Fourier Series</td>
<td>8 days*</td>
</tr>
<tr>
<td>10.6 &amp; 10.7 Optional</td>
<td></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>6.1-6.8</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 considered. The text is a bit skimpy in the variety of examples and contexts in which separation of variables is used, especially with regard to Laplace's equation. It should be augmented somewhat.

Course Coordinator:
George Majda
2000-2001
Prerequisite:
Mathematics 254

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

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

Texts:
There are three possibilities:

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

Topics & Sample Syllabus

<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>3 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>3 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>5 days</td>
</tr>
</tbody>
</table>

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

(Or different text:
Using Kreyszig, cover Chapters 8 and 9. This text is too terse and must be augmented slightly. (e.g. using Schaum's Outline))
Mathematics 514
Sp
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:**

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><strong>TEST</strong></td>
<td></td>
</tr>
<tr>
<td>Mapping by elementary functions</td>
<td>3</td>
</tr>
<tr>
<td>Cauchy integral theorem and consequences</td>
<td>5</td>
</tr>
<tr>
<td><strong>TEST</strong></td>
<td></td>
</tr>
<tr>
<td>Power series</td>
<td>3</td>
</tr>
<tr>
<td>Residues, definite integrals</td>
<td>6</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>4</td>
</tr>
<tr>
<td>Complex functions and potential theory: (if time permits and prior material is grasped)</td>
<td></td>
</tr>
</tbody>
</table>

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

**Course Coordinator:**  
George Majda  
2000-2001
Prerequisites:

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

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

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

Catalog Descriptions:

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

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

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

Purpose of Course:

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

Texts vary, for example:

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

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

Course Coordinator:  
V. Bergelson (Honors)  
2000-2001
Mathematics 530  
3 cr.  
Probability I

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

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

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

Follow-up Course
Math 531 if it is offered.

Text:
Probability, Jim Pitman.

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

Course Coordinator:
Neil Falkner
2000-2001
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.
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
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 \( \mathbb{E}^n \).

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

Follow-up course
Math H541.

Text
Elements of Differential Geometry. R. Millman and G. Parker, (or similar level text)
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 540, or permission of the instructor

**Catalog Description**

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.

**Purpose of Course**

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

**Text**

*Elements of Differential Geometry*, R. Millman and G. Parker
(or similar level text)
Mathematics 547 3 cr. Introductory Analysis I

A, W

Prerequisite:
Mathematics 345.

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

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

Follow-up Course:
Math 548.

Text:
Introduction to Analysis, Arthur Mattuck

Topics:
Mathematics 548 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 Analysis, Arthur Mattuck

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
Au,Sp

3 cr.

Introductory Analysis III

Prerequisite:
Mathematics 548.

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

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

Text:
Introduction to Analysis. Arthur Mattuck

Topics:
1. Taylor’s Theorem.
3. Fundamental Theorem of Calculus. Integraton by parts and change of variable.
4. Exponential and logarthmic function.
5. Improper integrals.
6. Functional sequences and series.
7. Uniform convergence.
8. Power series and analytic functions.
Mathematics 551  5 cr.  Vector Analysis
Au, Sp

Prerequisite:
Mathematics 254

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

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

Text:
Vector Calculus, Thomas H. Barr

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

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.

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

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

Course Coordinator:
Luis Casian
2000-2001

DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
231 WEST EIGHTEENTH AVENUE
COLUMBUS, OHIO 43210-1174
Mathematics 552  
Su  
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 or 416. Because the course has minimal prerequisites, the emphasis will be on problem solving techniques. This course is not open to students with credit for 416 or 514.

**Text:**

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.
Prerequisite:
Mathematics 255, and prerequisite or concurrent 572.

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

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

Text:
Ordinary Differential Equations and Stability Theory: An Introduction, Sanchez

Topics & Sample Syllabus

<table>
<thead>
<tr>
<th>Topics</th>
<th>Approximate Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>Linear Systems of Differential Equations</td>
<td>4 weeks</td>
</tr>
<tr>
<td>Existence and Uniqueness</td>
<td>1 week</td>
</tr>
<tr>
<td>Qualitative Analysis of Nonlinear Equations in the Plane</td>
<td>5 weeks</td>
</tr>
</tbody>
</table>

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

Note:
This course will not be offered in 2000-2001.
Prerequisite:
Mathematics 556

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

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

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

Topics and Sample Syllabus

<table>
<thead>
<tr>
<th>Sections</th>
<th>Topics</th>
<th>Approximate Time</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1-1.4</td>
<td>Where PDE's Come From</td>
<td>2 weeks</td>
</tr>
<tr>
<td>2.1-2.5</td>
<td>Waves &amp; Diffusion</td>
<td>2 weeks</td>
</tr>
<tr>
<td>4.1-4.3</td>
<td>Boundary Value Problems</td>
<td>2 weeks</td>
</tr>
<tr>
<td>5.1-5.4</td>
<td>Fourier Series</td>
<td>2 weeks</td>
</tr>
<tr>
<td>6.1-6.3</td>
<td>Harmonic Functions</td>
<td>2 weeks</td>
</tr>
</tbody>
</table>

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

Note:
This course will not be offered in 2000-2001.
Mathematics 568  
A, W, Sp, Su (1st Term)  

3 cr.  
Introductory Linear Algebra I

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

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>
<th>Sections</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>1.1</td>
<td>LINEAR EQUATIONS IN LINEAR ALGEBRA</td>
<td>4.1</td>
<td>VECTOR SPACES</td>
</tr>
<tr>
<td>1.2</td>
<td>Systems</td>
<td>4.2</td>
<td>Subspaces</td>
</tr>
<tr>
<td>1.3</td>
<td>Row Reduction</td>
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<td>Null Spaces and Column</td>
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<tr>
<td>1.4</td>
<td>Vector Equations</td>
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<td>Spaces</td>
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<tr>
<td>1.5</td>
<td>The Matrix Equation</td>
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<td>Independence and Basis</td>
</tr>
<tr>
<td>1.6</td>
<td>Solution Sets of Linear Systems</td>
<td>4.4</td>
<td>Dimension</td>
</tr>
<tr>
<td>1.7</td>
<td>Linear Independence</td>
<td>4.5</td>
<td>Rank</td>
</tr>
<tr>
<td>1.8</td>
<td>ORTHOGONALITY AND LEAST-SQUARES</td>
<td>4.6</td>
<td>Change of Basis</td>
</tr>
<tr>
<td>2.1</td>
<td>Inner Product, Length, Orthogonality</td>
<td>3.1-3.2</td>
<td>Determinants</td>
</tr>
<tr>
<td>2.2</td>
<td>Orthogonal Sets</td>
<td></td>
<td>Properties of Determinants</td>
</tr>
<tr>
<td>2.3</td>
<td>Orthogonal Projections</td>
<td>3.3</td>
<td>Cramer’s Rule</td>
</tr>
<tr>
<td>2.4</td>
<td>The Gram-Schmidt Process</td>
<td></td>
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</tr>
<tr>
<td>1.7</td>
<td>LINEAR EQUATIONS IN LINEAR ALGEBRA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>1.8</td>
<td>Introduction to Linear Transformations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.1</td>
<td>The Matrix of a Linear Transformation</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.2</td>
<td>MATRIX ALGEBRA</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.3</td>
<td>Matrix Operations</td>
<td></td>
<td></td>
</tr>
<tr>
<td>2.4</td>
<td>Inverses</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.1</td>
<td>Invertible Matrices</td>
<td>5.1</td>
<td>Eigenvectors</td>
</tr>
<tr>
<td>3.2</td>
<td>Eigenvalues</td>
<td>5.2</td>
<td>Characteristic Equation</td>
</tr>
<tr>
<td>3.3</td>
<td>Characteristic Equation</td>
<td>5.3</td>
<td>Diagonalization</td>
</tr>
<tr>
<td>3.4</td>
<td>EIGENVALUES AND EIGENVECTORS</td>
<td>5.4</td>
<td>Linear Transformations</td>
</tr>
<tr>
<td>4.1</td>
<td>VECTOR SPACES</td>
<td></td>
<td></td>
</tr>
<tr>
<td>4.2</td>
<td>Subspaces</td>
<td></td>
<td></td>
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<tr>
<td>4.3</td>
<td>Independence and Basis</td>
<td></td>
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<tr>
<td>4.4</td>
<td>Dimension</td>
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<tr>
<td>4.5</td>
<td>Rank</td>
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</tr>
<tr>
<td>4.6</td>
<td>Change of Basis</td>
<td></td>
<td></td>
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<tr>
<td>3.1-3.2</td>
<td>Determinants</td>
<td></td>
<td></td>
</tr>
<tr>
<td>3.3</td>
<td>Cramer’s Rule</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Course Coordinator: Bostwick Wyman  
2000-2001
Mathematics 569  
A, W, Sp, Su (2nd Term)  

3 cr.  
Introductory Linear Algebra II

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

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

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

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

For further information see:  
E. Overman  
2000-2001
Mathematics 571  
A, Sp, Su (1st Term)  
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.

<table>
<thead>
<tr>
<th>Leon:</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sections</td>
<td>Topics</td>
</tr>
<tr>
<td>Chapter 1</td>
<td>Matrices and Systems of Equations</td>
</tr>
<tr>
<td>Chapter 2</td>
<td>Determinants</td>
</tr>
<tr>
<td>Chapter 3</td>
<td>Vector Spaces</td>
</tr>
<tr>
<td>Chapter 5 (5.1-5.4)</td>
<td>Orthogonality</td>
</tr>
</tbody>
</table>
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.

Leon:

<table>
<thead>
<tr>
<th>Sections</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
<td>Chapter 5</td>
<td>Orthonormal Sets (Sections 5.5-end of chapter)</td>
</tr>
<tr>
<td>Chapter 4</td>
<td>Linear Transformations</td>
</tr>
<tr>
<td>Chapter 6</td>
<td>Eigenvalues</td>
</tr>
</tbody>
</table>
Mathematics 573 5 cr.  Elementary Number Theory
Sp of odd numbered years

Prerequisite:
Mathematics 153

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

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

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

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

Course Coordinator:
Ponomarev
2000-2001
Note: This course was not offered in Sp 2000 and will not be offered in Sp 2001.

Prerequisite:
Mathematics 568.

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

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

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

Topics:
Construction of the real projective plane from the affine plane, barycentric and homogeneous coordinates, duality, affine and projective transformations, double ratio. Conic sections, and the group of a conic section. Exercises on projective planes over $\mathbb{Z}$ mod p.
Mathematics 560 4 cr.  Point-Set Topology

Prerequisite:
Mathematics 345.

Catalog Description:

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

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

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

Topics & Sample Syllabus

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

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

Department of Mathematics
The Ohio State University
231 West Eighteenth Avenue
Columbus, Ohio 43210-1174

Course Coordinator:
Yung-Chen Lu
2000-2001
Mathematics 566
A, W, Sp, Su (2nd Term)

3 cr.

Discrete Mathematical Structures II

Prerequisite:
Mathematics 366.

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

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

Text:

Topics and Sample Syllabus

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

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.

(Over for Syllabus)
Topics List & Sample Syllabus:

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<thead>
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<th>Sections</th>
<th>Topics</th>
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<td>THE MATHEMATICS OF CHOICE</td>
</tr>
<tr>
<td>1.1</td>
<td>Fundamental Counting Principles</td>
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<td>1.2</td>
<td>Pascal's Triangle</td>
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<tr>
<td>1.5</td>
<td>Combinatorial Identities</td>
</tr>
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<td>1.6</td>
<td>Four ways to Choose</td>
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<tr>
<td>1.7</td>
<td>Binomial &amp; Multinomial Theorems</td>
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<tr>
<td>1.8</td>
<td>Partitions</td>
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<tr>
<td>1.9</td>
<td>Newton's Identities</td>
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<tr>
<td>Chapter 2</td>
<td>THE COMBINATORICS OF FINITE FUNCTIONS</td>
</tr>
<tr>
<td>2.1</td>
<td>Stirling Numbers---Second Kind</td>
</tr>
<tr>
<td>2.2</td>
<td>Bells, Ball, and Urns</td>
</tr>
<tr>
<td>2.3</td>
<td>Principle of Inclusion-Exclusion</td>
</tr>
<tr>
<td>2.4</td>
<td>Disjoint Cycles</td>
</tr>
<tr>
<td>2.5</td>
<td>Stirling Numbers---First Kind</td>
</tr>
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<td>Chapter 5</td>
<td>ENUMERATION IN GRAPHS</td>
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<tr>
<td>5.1</td>
<td>The Pigeonhole Principle</td>
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<td>5.2</td>
<td>Edge Colorings and Ramsey Theory</td>
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<tr>
<td>5.3</td>
<td>Chromatic Polynomials</td>
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<tr>
<td>5.4</td>
<td>Planar Graphs</td>
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<tr>
<td>5.5</td>
<td>Matching Polynomials</td>
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<td>5.6</td>
<td>Graphic Sequences</td>
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<td>DESIGNS AND CODES</td>
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<td>6.1</td>
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<tr>
<td>6.2</td>
<td>Balanced Incomplete Block Designs</td>
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</table>

As time permits:

<table>
<thead>
<tr>
<th>Sections</th>
<th>Topics</th>
</tr>
</thead>
<tbody>
<tr>
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<td>Difference Sequences</td>
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<td>4.2</td>
<td>Ordinary Generating Functions</td>
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<tr>
<td>4.3</td>
<td>Applications of Generating Functions</td>
</tr>
<tr>
<td>4.4</td>
<td>Exponential Generating Functions</td>
</tr>
<tr>
<td>4.5</td>
<td>Recurrence Techniques</td>
</tr>
</tbody>
</table>

Course Coordinator:
Thomas Dowling
2000-2001
Mathematics  H576  Wi*  5 cr. each  Number Theory
H577  Sp*  Through History I, II

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

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

Catalog Description:

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

H577:
Continuation of H576.

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

Texts:

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

(over for Suggested Topics List)
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

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

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

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

Text:
Discrete Dynamical Systems, Sandefur

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

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

1. Discrete deterministic models developed from numerical data.
2. Markov processes
3. Random processes and Monte Carlo simulation.
4. Linear optimization and the simplex algorithm.
5. Graph theory, including shortest paths, minimum weight spanning trees, and job scheduling.
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.
Mathematics 580  Au, Wi  3 cr. each  Algebra I
581  Wi, Sp  Algebra II
582  Sp, Au  Algebra III

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

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

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

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

Text:
Notes by R. Solomon

Topics:

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

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


Course Coordinator:
Ron Solomon
2000-2001
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.
<table>
<thead>
<tr>
<th>Mathematics</th>
<th>H590 Au</th>
<th>5 cr.</th>
<th>Algebraic Structures I</th>
</tr>
</thead>
<tbody>
<tr>
<td>H591 Wi</td>
<td>5 cr.</td>
<td></td>
<td>Algebraic Structures II</td>
</tr>
<tr>
<td>H592 Sp</td>
<td>5 cr.</td>
<td></td>
<td>Algebraic Structures III</td>
</tr>
</tbody>
</table>

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.

For Further Information See:

V. Bergelson (Honors)  
2000-2001
Mathematics 601  
Au  
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:
To make available an updated advanced-undergraduate/graduate course sequence which accommodates the academic (mathematical) and scheduling needs of client departments as well as those of the mathematics department.

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

(Over for Topics List)
Topics List

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

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

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

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

(* 1 day = one 48 min. lecture)

Grading Criteria:
Weekly homework and one final exam.

Follow-up Course:
Math 602

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

Course Coordinator:
Ulrich Gerlach
2000-2001
Prerequisite:

Mathematics 601

Catalog Description:

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

Purpose of Course:

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

Text:

I. Eigenvalues and eigenvectors:

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

II. & III. Infinite-dimensional vector spaces:

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

(over for Topics List)
Mathematics 602
Page 2

Topics List

I. EIGENVALUES AND EIGENVECTORS
   (approximately 20 days*)

   Hermitian 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)

Grading Criteria:

Weekly homework and one final exam.

Follow-up Course:

Math 603

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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)
Mathematics 603.02
Page 2

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

(*1 day = one 48 min. lecture)

Grading Criteria:
Weekly homework and one final exam.

Possible Follow-up Course
Math 701
Mathematics 618 3 cr. Theory of Interest
Wi (Two 1 1/4-hour classes)

Prerequisite:
Mathematics 254, or permission of instructor.

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

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

Text:

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

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

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

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

Text:

For further information see:  
Bostwick Wyman  
2000-2001
Mathematics 650
Su

5 cr.
Principles of Mathematical Analysis

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
652 Wi
653 Sp
Introduction to Real Analysis I
Introduction to Real Analysis II
Introduction to Real Analysis III

Prerequisite:
Permission of Department.

Catalog Description:

651: Real numbers, infinite sequences and series.

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

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

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

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

Possible Texts:

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

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

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

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

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

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For Further Information see:
Paul Nevai
2000-2001
Mathematics 655 Au 4 cr. Each Elementary Topology I
656 Wi Elementary Topology II
657 Sp Elementary Topology III

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

Catalog Descriptions:

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

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

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

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

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

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

Possible Texts:


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

Topics List:

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

Possible Additional Topics:

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

See also: http://www.math.ohio-state.edu/~fiedorow/math655
Mathematics 670 Au 5 cr. Algebra I
671 Wi Algebra II
672 Sp Algebra III

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

Catalog Descriptions:

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

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

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

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

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

Text:

Abstract Algebra, Dummit & Foote (used starting in 670, Au 95)
or
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), Bases, Change of Basis; Linear Operators and their Matrices, Rank and Nullity, Determinants, Eigenvalues and Eigenvectors, Minimal and Characteristic Polynomials and the Cayley-Hamilton Theorem; Simultaneous Diagonalization</td>
<td>5 weeks</td>
</tr>
<tr>
<td>BASIC GROUP THEORY</td>
<td></td>
</tr>
<tr>
<td>Elementary Concepts: Element Order, Cyclic Groups, Lagrange's Theorem</td>
<td>2 weeks</td>
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<tr>
<td><strong>671:</strong></td>
<td></td>
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<tr>
<td>Statement and Proof of Structure Theorem on Finitely Generated Abelian Groups.</td>
<td>3 weeks</td>
</tr>
<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></td>
</tr>
<tr>
<td>Bilinear and Hermitian Forms, Inner Product Spaces, Gram-Schmidt, Orthogonal Decompositions and Projections</td>
<td>2 weeks</td>
</tr>
<tr>
<td><strong>672:</strong></td>
<td></td>
</tr>
<tr>
<td>BASIS COMMUTATIVE RING THEORY</td>
<td></td>
</tr>
<tr>
<td>Rings (with 1), Homomorphisms, Ideals, Principal Ideals, Prime and Maximal Ideals, Quotient Rings. PID's, UFD's. Ideals and Quotients of k[x].</td>
<td>4 weeks</td>
</tr>
<tr>
<td>GALOIS THEORY</td>
<td></td>
</tr>
<tr>
<td>Finite Extensions of Q, Basic Galois Correspondence. Finite Fields. Solvability by Radicals. Straight-edge and Compass Constructions.</td>
<td>6 weeks</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.)

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231 WEST EIGHTEENTH AVENUE  
COLUMBUS, OHIO 43210-1174

Course Coordinator: 
Joe Ferrar