Department of Mathematics
The Ohio State University

1989-1991 Mathematics Courses

Course Number	Course Title
50	Pre-College Mathematics I
75	Pre-College Mathematics II
76	Reentry Precollege Math
104	Basic College Mathematics
105	Mathematics for Elementary Teachers I
106	Mathematics for Elementary Teachers II
107	Topics in Mathematics for Elementary Teachers
116	Survey of College Algebra
117	Survey of Calculus
130	Elements of Algebra
131	Elements of Calculus I
132	Elements of Calculus II
148	College Algebra
150	Elementary Functions
151	Calculus and Analytic Geometry
152	Calculus and Analytic Geometry
153	Calculus and Analytic Geometry
161	Accelerated Calculus with Analytic Geometry
162	Accelerated Calculus with Analytic Geometry
187	Topics in Mathematics
190H	Elementary Analysis I
191H	Elementary Analysis II
264H	Elementary Analysis III
254	Calculus and Analytic Geometry
255	Differential Equations and Their Applications
263	Accelerated Calculus and Analytic Geometry
345	Foundations of Higher Mathematics
366	Discrete Mathematical Structures I
415	Ordinary and Partial Differential Equations
416	Vector Analysis and Complex Variables
471	Matrices and Linear Algebra
487H	Advanced Problem Solving
501	Fundamentals of Mathematics I

Course Number	Course Title
502	Fundamentals of Mathematics II
503	Fundamentals of Mathematics III
501S	General Mathematics Review for Students of Actuarial Science
504	History of Mathematics
507	Advanced Geometry
510.01	Topics in Mathematics for Elementary School Teachers
510.02	Topics in Mathematics for Elementary School Teachers
510.03	Topics in Mathematics for Elementary School Teachers
512	Partial Differential Equations and Boundary Value Problems
513	Vector Analysis for Engineers
514	Complex Variables for Engineers
520H	Linear Algebra Differential Equations Complex Analysis
521H	Linear Algebra Differential Equations Complex Analysis
522H	Linear Algebra Differential Equations Complex Analysis
530	Probability
531	Probability II
540H	Geometry and Calculus in Euclidean Spaces and on Manifolds I
541H	Geometry and Calculus in education Spaces and on Manifolds II
547	Introductory Analysis I
548	Introductory Analysis II
549	Introductory Analysis III
551	Vector Analysis
552	Introduction to the Theory of Functions of a Complex Variable
556	Differential Equations I
557	Differential Equations II
558	Differential Geometry of Curves and Surfaces
560	Point-Set Topology
566	Discrete Mathematical Structures II
568	Introductory Linear Algebra I
569	Introductory Linear Algebra II
571	Linear Algebra for Applications I
572	Linear Algebra for Applications II
573	Elementary Number Theory
574	Geometry
575	Combinatorial Mathematics & Graph Theory
578	Discrete Mathematical Models
580	Algebra I
581	Algebra II
582	Algebra III
590H	Algebraic Structures I

Course Number	Course Title
591H	Algebraic Structures II
592H	Algebraic Structures III
594H	Topics in Mathematics
601	Mathematical Methods in Science I
602	Mathematical Methods in Science II
604	Introduction to Continuous Applied Mathematics I
605	Introduction to Continuous Applied Mathematics II
606	Introduction to Numerical Analysis of Partial Differential Equations
610.01	Topics in Mathematics for Teachers
610.02	Topics in Mathematics for Teachers
610.03	Topics in Mathematics for Teachers
610.04	Topics in Mathematics for Teachers
610.25	Topics in Mathematics for Teachers
611	Geometric Linear Algebra
612	Elementary Geometry from an Advanced Standpoint
613	Number Theory and Algebra
614	Calculus from a Numerical Viewpoint
615	Foundations of Calculus
616	Numerical Methods in Actuarial Mathematics
618	Theory of Interest
621	Probability
630	Mathematics of Life Contingencies I
631	Mathematics of Life Contingencies II
632	Mathematics of Life Contingencies III
634	Linear Mathematical Models
635	Game Theory
640	Introductory Topology
645	Foundations of Higher Mathematics
647	Set Theory
648	Mathematical Logic I
649	Mathematical Logic II
650	Principles of Mathematical Analysis
651	Introduction to Real Analysis I
652	Introduction to Real Analysis II
653	Introduction to Real Analysis III
654	Complex Variables
665	Modern Mathematical Methods in Relativity Theory I
666	Modern Mathematical Methods in Relativity Theory I
669	Introduction to Number Theory
670	Algebra I

Course Number	Course Title
671	Algebra II
672	Algebra III
674	Survey of Combinatorial Mathematics
675	Applied Discrete Mathematics I
676	Applied Discrete Mathematics II
677	Applied Discrete Mathematics III
701	Mathematical Methods In Science III
702	Integral Equations and Eigenvalue Problems
703	Integral Equations and Eigenvalue Problems II
705	Special Functions
707	Theoretical Numerical Analysis I
708	Theoretical Numerical Analysis II
709	Theoretical Numerical Analysis III
722	Theory of Probability I
723	Theory of Probability II
735	Seminar in Teaching College Mathematics for International Graduate Students
736	Seminar in Teaching College Mathematics for Domestic Graduate Students
741	Mathematical Foundations of the Design and Use of Automatics Systems I
742	Mathematical Foundations of the Design and Use of Automatics Systems II
750	Real Analysis I
751	Real Analysis II
752	Real Analysis III
753	Introduction to Complex Analysis I
754	Introduction to Complex Analysis II
760	Ordinary Differential Equations I
761	Ordinary Differential Equations II
763	Partial Differential Equations and Their Applications I
764	Partial Differential Equations and Their Applications II
767	Introduction to the Theory of Approximation I
768	Introduction to the Theory of Approximation II
770	Algebra I
771	Algebra II
772	Algebra III
775	Combinatorics & Graph Theory I
776	Combinatorics & Graph Theory II
777	Combinatorics & Graph Theory III
780	Number Theory I
781	Number Theory II Diophantine Equations
782	Number Theory III
783H	

Course Number	Course Title
787.01	Problems in Abstract Algebra
787.02	Problems in Complex Analysis
787.03	Problems in Real Analysis
787.04	Problems in Topology
787	Graduate Problem Seminars
804	Methods of Applied Mathematics I
805	Methods of Applied Mathematics II
806	Methods of Applied Mathematics III
854	Lie Groups I
857	Introduction to Financial Analysis I
858	Introduction to Financial Analysis II
859	Introduction to Financial Analysis III
860	Algebraic Topology I
861	Algebraic Topology II
862	Algebraic Topology III
872	Group Theory I
873	Group Theory II
874	Group Theory III

Mathematics 050 **5 cr.** **Precollege Mathematics I**
A, W, Sp, Su

Prerequisite:

Course Code T on Math Placement Test.

Catalog Description:

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

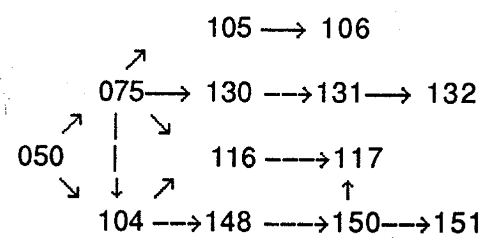
Purpose of Course:

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

Follow-up Course:

Math 075 or Math 104

Sequencing Chart:



Text:

Essential Algebra: A Calculator Approach, F. Demana and J. Leitzel
(Addison-Wesley, Publishers)
Chapters 1 - 6, 11.1

Possible Study Guide: Schaum's Outline Series -- Elementary Algebra

Topics List

1. Review of arithmetic, fractions, mixed numbers, and decimals

2. The number line -- rational and real numbers

3. Properties of numbers
   - prime factors
   - order of operations
   - greatest common factor
   - division algorithm
   - divisibility
   - least common multiple
   - distributive property
   - Euclidean algorithm

4. Arithmetic of signed numbers, properties of real numbers

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

6. Word problems

7. Solving linear equations and linear inequalities

8. Applied problems and formulas
   - ratio, proportion, percent
   - inflation
   - numerical solutions of equations
   - compound interest
   - population growth
   - geometric formulas

9. Scientific notation

10. Graphs of equations
    - introduction to ordered pairs
    - rational equations
    - problem solving graphically
    - graphs of polynomial equations
    - exponential equations

11. Linear equations, slope
    - standard form, point-slope form, slope-intercept form

12. Basic geometric figures and areas
    - triangles, polygons, circles

13. Extensive use of calculators

Course Coordinator:
Frank Demana
Spring, 1989

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

Prerequisite:

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

Catalog Description:

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

Purpose of Course:

To meet the needs of students entering the University with Course Code S on Math Placement Test, or with credit for 050. In addition, **students placing at Course Code R** and who need Math 130, must take 075 or 104 prior to enrolling in 130. 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, 116, or 130.

Follow-up Courses:

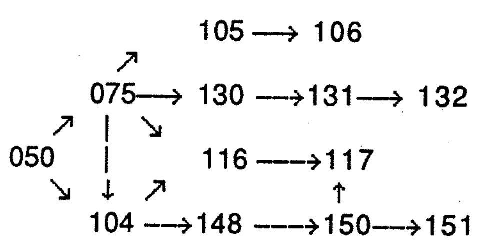
Math 104 for students switching to science, computer science or engineering curriculum.

Math 105 for elementary education majors.

Math 116 for students in arts and sciences, general agriculture, or social science.

Math 130 for students in the College of Business (except CIS majors).

Sequencing Chart:



Text:

Essential Algebra: A Calculator Approach, F. Demana and J. Leitzel (Addison- Wesley Publishers). Chapters 6.5, 6.6, 7 - 10, 11.3, 11.6- 11.9.

Possible Study Guide: Schaum's Outline Series -- Elementary Algebra

Topics List

1. Review of linear equations
   - standard form
   - slope-intercept form
   - point-slope form
2. Parallel and perpendicular lines
3. Linear inequalities
4. Systems of linear equations
   - two variables
   - three variables
   - applications
5. Polynomials
   - addition, subtraction and multiplication
   - division with quotient and remainder
6. Factoring polynomials
   - common monomial factor
   - quadratics
   - by grouping
7. Rational roots and factors
8. Fractional exponents
9. Simplifying radical expressions
10. Solving quadratic equations
    - by factoring
    - by completing the square
    - use of the quadratic formula
11. Variation
12. Simplifying rational expressions
    - addition and subtraction
    - multiplication and division
    - complex fractions
13. Solution of fractional equations and applications
14. Right triangle trigonometry
15. Inverse trig functions
16. Applications
    - leading to quadratic equations
    - involving rational expressions
    - solving right triangles
17. Extensive use of calculators

Course Coordinator:
Frank Demana
Spring, 1989

Mathematics 076 **4 cr.** **Reentry Precollege Math**
A, W, Sp, Su

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, 116, or 130. 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, or engineering.
- Math 105 for elementary education majors.
- Math 116 for students in arts and sciences, general agriculture, or social science.
- Math 130 for students in the College of Business (except CIS majors).

Sequencing Chart:

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              105 ──→ 106
            ↗
         075──→ 130 ──→131──→ 132
       ↗  |  ↘
   050    |     116 ───→117
       ↘  ↓  ↗            ↑
         104 ──→148 ───→150──→151
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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. Rationals 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

Course Coordinator:
Gloria Woods
Spring, 1988

Mathematics 104 **5 cr.** **Basic College Mathematics**
A, W, Sp, Su

Prerequisite:

Mathematics 050, or 075, or Course Code S or 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 S on Math Placement Test, or with credit for 050. In addition, **students placing at Course Code R, and who need Math 148**, must take 104 prior to enrolling in 148. Completion of Math 104 is required for entry into some degree granting colleges.

Follow-up Course:

Math 148.

Sequencing Chart:

```
              105 ──→ 106
            ↗
         075──→ 130 ──→131──→ 132
       ↗  |  ↘
   050    |     116 ──→117
       ↘  ↓          ↑
         104 ──→148 ──→150──→151
```

Text:

<u>Intermediate Algebra, Applications and Problem Solving</u>, Phillips, Butts and Shaughnessy, (Harper and Row), Chapters 1 - 9

Topics List

1. Review of inequalities and absolute value
2. Polynomials -- addition and subtraction
   multiplication and division
3. Translating phrases into algebraic expressions
4. Solving linear inequalities
5. Graphing linear inequalities

6. Equations and inequalities involving absolute value
7. Linear equations and slope -- standard form
   slope-intercept
   point-slope form
8. Properties of linear graphs
9. Systems of equations in two and three variables and applications
10. Factoring -- common monomial factor
    quadratics
    by grouping

11. Simplifying rational expressions -- addition and subtraction
    multiplication and division
    complex fractions
12. Solving fractional equations

13. Quadratic equations -- factoring
    use of quadratic formula
    completing the square
    graphing
14. Rational exponents
15. Distance in the plane
16. Radical expressions
17. Radical and exponential equations
18. Functions and graphs
19. Variation

Course Coordinator:
G. Edgar
Spring, 1989

Mathematics 105 **5 cr.** **Mathematics for Elementary Teachers I**
A, W, Sp

Prerequisite:

Mathematics 075 or 104, or Course Code L, M, N or R on Math Placement Test.

Catalog Description:

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

Purpose of Course:

To develop an appreciation of, and basic competency in, the use of analytical thought in the development of a cohesive body of useful mathematical knowledge. Special emphasis on topics encountered in the elementary school mathematics program.

Follow-up Course:

Math 106

Text:

Mathematics for Elementary School Teachers, 2nd Edition, James Schultz, (Merrill Publishing).

Chapters 1-4 plus OSU Math 105 Supplements, Ferrar and Leitzel.

Topics:

Basic concepts dealing with whole numbers, combinatorial counting procedures, elementary intuitive geometry, measurement.

Course Coordinators:
Joe Ferrar
Jim Schultz

Spring, 1989

Mathematics 106 **5 cr.** **Mathematics for Elementary Teachers II**
A, Sp

Prerequisite:

Mathematics 105

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. Special emphasis on topics encountered in the elementary school mathematics program.

Follow-up Course:

Math 107

Text:

Mathematics for Elementary School Teachers, 2nd Edition, James Schultz, (Merrill Publishing).

Chapters 5-12 plus OSU Math 106 Supplements, Ferrar and Leitzel.

Topics:

Rational numbers (fractions, decimals), real numbers, elementary probability, geometry (congruence, similarity, ruler, compass constructions).

Course Coordinators:
Joe Ferrar
Jim Schultz

Spring, 1989

Mathematics 107 **5 cr.** **Topics in Mathematics For Elementary Teachers**
Wi

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.

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

Course Coordinators:
Joe Ferrar
Jim Schultz

Spring, 1989

Mathematics 116 **5 cr.** **Survey of College Algebra**
A, W, Sp, Su

Prerequisite:

Mathematics 075 or 104, or Course Code R on Math Placement Test.

Catalog Description

The sequence 116, 117 treats topics applicable to non-physical sciences. Topics in 116 include college algebra, analytic geometry, linear algebra, and linear programming.

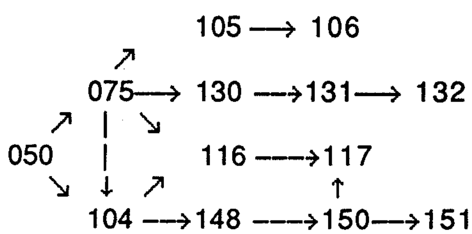
Purpose of Course:

The emphasis in this course is on intuitive understanding and developing some facility for applying mathematical ideas to problem solving. It is hoped that students may feel less intimidated by terminology and symbolism. 116 and 117 should give the students an overview of college algebra and differential and integral calculus. The applications are selected from business and economics, and the life and social sciences.

Follow-up Courses:

Students pursuing a Bachelor of Arts degree in The College of The Arts and Sciences may elect 116 and 117 to complete the Arts and Sciences (ASC) 10 hour requirement in category II: Mathematical and Logical Analysis. Alternatively, students in ASC may also elect any course from CIS, Statistics, Philosophy 150 or 250, or any Math course above 108 to fulfill the 10 hour requirement of category II.

Sequencing Chart:



Text:

College Mathematics for Management, Life, and Social Sciences, 4th Edition, R. A. Barnett and Michael R. Ziegler (Dellen Publishing, Co., San Francisco): Appendix A, chapters 0, 1, 2, 3, 9.1

TOPICS LIST

Section	Topics
A-1	Integer exponents and square root radicals
A-2	Rational Exponents and radicals
A-3	Algebraic Expression: Basic operations
A-4	Algebraic Fractions
0-1	Sets
0-2	Linear equations and inequalities in one variable
0-3	Quadratic equations
0-4	Coordinates, lines
0-5	Functions and Graphs
0-6	Exponential Functions
0-7	Logarithmic Functions
1-1	Systems of linear equations
1-2	Augmented matrices
1-3	Gauss-Jordan elimination
1-4	Elimination, matrix operations
1-5	Matrix multiplication
1-6	Inverse matrix, matrix equations
2-1	Linear inequalities in two variables
2-2	Linear programming
3-1,3-2	Simple and compound interest
9-1	e, continuous compound interest

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

Course Coordinator:
Thomas Ralley

Spring, 1989

Mathematics 117 **5 cr.** **Survey of Calculus**
A, W, Sp, Su

Prerequisite:

Mathematics 116 or 130 or 148 or 150

Catalog Description:

An introduction to differential and integral calculus.

Purpose of Course:

The audience is made up of Architecture (30-40%) and Natural Resources (20-30%) majors for whom the course is a requirement, with the balance being ASC students seeking to complete the category II ASC requirement for the BA degree. 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. The Barnett and Ziegler text provides numerous problems to support this approach.

Follow-up Courses:

There are really no follow-up courses. A student with interests in business who does A or B work in Math 117 should have a reasonable chance to survive in Math 132. 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 Mathematics Building, Room 110.

Text:

College Mathematics for Management, Life, and Social Sciences, 4th Edition, R.A. Barnett and Michael R. Ziegler, (Dellen Publishing Co., San Francisco): chapters 7-10, 11.1.

TOPICS LIST

Section	Topics
0-5	Functions and Graphs
0-6	Exponential Functions
0-7	Logarithm Functions
7-1, 7-2	Limits and continuity
7-3	Increments, tangent lines, rates of change
7-4	The derivative
7-5	Derivatives of constants, powers, sums
7-6	Derivatives of products and quotients
7-7	Chain rule, general power rule
8-1	First derivatives and graphs
8-2	Second derivatives and graphs
8-3	Optimization
8-4	Curve Sketching (2 days)
9-1	Review of exponentials, logarithms and e. Continuous compound interest
9-2	Derivative of the logarithmic and exponential functions
9-3	Chain Rule
10-1	Anti-derivatives, indefinite integral
10-2	Integration by substitution
10-3	Differential equations: Growth and decay
10-4	Definite integral
10-5	Area
11-1	Definite integral as the limit of a sum

Course Coordinator:
Tom Ralley

Spring, 1989

Prerequisite:

Mathematics 075 or 076 or 104, or Course Code N on Math Placement Test.

Catalog Description:

Equations, inequalities, absolute value, functions, exponential and logarithmic functions, systems of equations, and matrix algebra.

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:

Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences, Ernest F. Hauessler and Richard S. Paul, 5th Edition.

Topics:

Algebra refresher, linear and quadratic equations
and applications of equations
Linear Inequalities, Applications of Equations
Applications of Inequalities, Quadratic Inequalities

Functions, Combination of Functions
Graphs of Functions
Graphing Techniques

Fractional Exponents and Radical Notion
Exponential Functions and Graphs
Logarithmic Functions and Graphs

Laws of Logarithms
Applications of Exponential and Logarithmic
Functions

Simple Interest and Discount
Compound Interest and Present Value
Annuities, Sinking Funds

Annuities; Amortization of Loans
Systems of Linear Equation, Application of
Systems of Equations
Linear Programming in Two Dimensions

Course Coordinator:
Gloria Woods

Spring, 1988

Mathematics 131 **4 cr** **Elements of Calculus I**
A, W, Sp, Su

Prerequisite:

Mathematics 116 or 130 or 148 or 150, or Course Code L on Math Placement Test.

Catalog Description:

Limits, tangent lines, derivatives, logarithmic and exponential functions, graphing techniques, applications of calculus to business.

Purpose of Course:

The 131 and 132 courses are designed to introduce students in the College of Business to differential and integral calculus and related business applications. These courses are problem oriented and little rigor is introduced.

Follow-up Course:

Math 132

Text:

Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences, Ernest F. Hauessler and Richard S. Paul, 5th Edition, chapters 10-13.

TOPICS

1. Limits
2. Interest Compounded Continuously, Continuity
3. Continuity Applied to Inequalities
4. Derivatives
5. Rules for Differentiation, Derivatives as a Rate of Change
6. Differentiability and Continuity, Product & Quotient Rules
7. Chain Rule and Power Rule, Derivatives of Logarithmic Functions
8. Derivatives of Exponential Functions, Implicit Differentiation
9. Logarithmic Differentiation, Higher Order Derivatives
10. Intercepts and Symmetry
11. Asymptotes
12. Relative Maxima and Minima
13. Concavity
14. Second Derivative Test
15. Applied Maxima and Minima
16. Applied Maxima and Minima
17. Differentials

Course Coordinator:
Surinder Sehgal
Spring, 1989

Mathematics 132 **4 cr.** **Elements of Calculus II**
Au, Wi, Sp, Su

Prerequisite:

Mathematics 131 or 117 or 151

Catalog Description:

Anti-differentiation, definite integral, integral of the logarithmic and exponential functions, techniques of integration, areas, differential equations, functions of several variables,partial derivatives, extrema, Lagrange multipliers, applications of calculus to business.

Purpose of Course:

The 131 and 132 courses are designed to introduce students in the College of Business to differential and integral calculus for one and several variables and related business applications. The courses are problem oriented and little rigor is introduced.

Follow-up Courses:

Stat 133 for most students in Business.

Math 150 for those students switching majors and needing the main-line calculus sequence. **CAUTION:** Students completing 132 may **not** enroll in 153.

Text:

Introductory Mathematical Analysis for Business, Economics, and the Life and Social Sciences, Ernest F. Hauessler and Richard S. Paul, 5th edition, chapters 14, 15, 17.

Topics List

1.	Indefinite Integral, Integration Formulas	(14.1, 14.2)
2.	Techniques of Integration	(14.3)
3.	Summation, Definite Integral, Fundamental Theorem	(14.4, 14.5, 14.6)
4.	Area, Area Between Curves	(14.7, 14.8)
5.	Consumers and Producers Surplus	(14.9)
6.	Integration by Parts	(15.1)
7.	Integration by Tables	(15.3)
8.	Average Value	(15.4)
9.	Differential Equations	(15.6)
10.	Improper Integrals	(15.8)
11.	Functions of Several Variables	(17.1)
12.	Partial Derivatives	(17.2)
13.	Applications of Partial Derivatives, Higher-Order Partials	(17.3, 17.5)
14.	Maxima and Minima	(17.7)
15.	Lagrange Multipliers	(17.8)

Course Coordinator:
Thomas Schwartzbauer

Summer, 1989

Mathematics 148 **4 cr** **College Algebra**
A, W, Sp, Su

Prerequisite:

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

Catalog Description:

Rational exponents, inequalities, functions, graphs of polynomial and rational functions, conic sections, zeros of polynomials.

Purpose of Course:

The two courses, Math 148 and 150, consist of precalculus concepts and skills needed by the student entering the regular calculus sequence (151, 152, etc.). The purpose of the two courses is to prepare the student for the regular calculus sequence.

Follow-up Course:

Math 150

Text:

~~Fundamentals of Algebra and Trig with Analytic Geometry, 6th Edition, Swokowski.~~
~~Chapters 1 (Review), 2, 3, 4, 11.1 - 11.4~~

not valid effective Au 89
change to CASIO grapher
using College Algebra & trig
by Demana & Waits

Topics List

I. Fundamental Concepts of Algebra (Review)

- Exponents -- integral and fractional
- Radicals
- Absolute Value
- Factoring

II. Equations and Inequalities

- Quadratic equations
- Equations with radicals
- Equations quadratic in form
- Inequalities and sets
- Equations and inequalities containing absolute values
- Quadratic inequalities

III. Functions

- Coordinate system
- Relations and graphs
- Functions -- one to one, onto, domain and range
- Composite and inverse functions
- Graphs of functions
- Altering of graphs by expansions, contractions, translations, and reflections.

IV. Polynomial Functions, Rational Functions, and Conic Sections

- Quadratic functions -- properties and graphs
- Graphs of polynomial functions of degree > 2
- Rational functions -- properties and graphs
- Conic sections -- standard forms and graphs
- Polynomial Division

V. Introduction to Complex Numbers and Complex Roots of Equations

Course Coordinator:
Bert Waits

Spring, 1988

Mathematics 150 **5 cr.** **Elementary Functions**
A, W, Sp, Su

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

Catalog Description:

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

Purpose of Course:

This course treats the functions needed by the students entering the regular calculus sequence (151, 152, etc.). The purpose of Math 150 is to prepare the student for the regular calculus sequence. With 148, the course covers traditional pre-calculus mathematics.

Follow-up Course:
Math 151

Text:
Algebra and Trigonometry with Analytic Geometry, 6th Edition, Swokowski. Chapters 2.4, 5, 6, 7, 8.

Topics List

I. Exponential and Logarithmic Functions
  - Exponential functions -- properties and graphs
  - Logarithmic functions -- properties and graphs
  - Solving logarithmic and exponential equations

II. General Trigonometry
  - Trig Functions
  - Angles
  - Trig functions of angles
  - Graphs
  - Right triangle applications

III. Analytic Trigonometry
  - Trig identities
  - Trig equations
  - Addition formulas
  - Multiple angle formulas
  - Inverse trig functions
  - Applications of trigonometry
  - Laws of sines and cosines
  - Vectors

IV. Complex numbers
  - Definition of complex numbers
  - Conjugates and inverses
  - Complex roots of equations
  - Trig form of complex numbers
  - Powers and roots of complex numbers
  - DeMoivre's Theorem

only valid for Aut 89
changing to CASIO
graphic approach
using new text
College Algebra + Trig —
A graphing approach

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

A day-to-day syllabus is distributed every quarter.

Course Coordinator:
Zita Divis
Spring, 1988

Mathematics 151 | **5 cr.** | **Calculus and Analytic Geometry**
A, W, Sp, Su

Prerequisite:

Mathematics 150 or Course Code L on Math Placement Test.

Catalog Description:

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

Purpose of Course:

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

Follow-up Course:

Math 152

Text:

Calculus and Analytic Geometry, 2nd Edition, Edwards and Penney.
Portions of Chapter 1; Chapters 2, 3, 4.

SECTION	TOPICS
1.4	Straight lines
1.6	Tangent lines and derivatives
2.1-2.2	Limits and one-sided limits
2.3	Combinations of functions, inverses
2.4	Continuity
2.5	Limits of trig functions
3.1	Derivative
3.2	Differentiation rules
3.3	Algebraic functions
3.4	Max-min's of functions
3.5	Applied Max-Min Problems
3.6	Derivatives of sin and cosine
3.7	Chain Rule
3.8	Implicit differentiation
3.9	Related rates
3.10	Newton's Method
4.2	Differentials
4.3	Mean Value Theorem
4.4	First derivative test
4.5	Graphs of polynomials
4.6	Concavity
4.7	Curve sketching
4.8	Antiderivatives
4.9	Velocity and acceleration

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Course Coordinator:
Frank Carroll

Spring, 1989

Mathematics 152 **5 cr.** **Calculus and Analytic Geometry**
A, W, Sp, Su

Prerequisite:

Mathematics 151

Catalog Description:

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

Purpose of Course:

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

Follow-up Course:

Math 153

Text:

Calculus and Analytic Geometry, 2nd edition, Edwards and Penney.

Edwards and Penney

Chapter	Title	Approximate # of weeks
5	The Integral	2
6	Applications of the Integral	1.5
7	Exponentials and Logarithms	1.5
8	Trigonometric and Hyperbolic Functions	1
9	Techniques of Integration	2
10	Polar Coordinates, area in polar coordinates	.5

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Course Coordinator:
Frank Carroll
Spring, 1989

Mathematics 153 | **5 cr.** | **Calculus and Analytic Geometry**

A, W, Sp, Su

Note: The following syllabus takes effect Au 89. See previous ed. of the course syllabi book for the previous syllabus.

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, 2nd edition, Edwards & Penney.

Chapters 11, 12, 13, 14.

TOPICS LIST

- Indeterminate forms
- Taylor's theorem
- improper integrals
- sequences and series
- convergence of sequences and series
- integral and comparison tests
- root and ratio tests
- alternating series
- absolute convergence
- parametric curves
- vectors in the plane and 3 dimensions
- lines and planes
- curves and motion
- cylinders and quadric surfaces
- cylindrical and spherical coordinates

Course Coordinator:
Ted Scheick

Spring, 1989

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Mathematics 161 **5 cr.** **Accelerated Calculus and Analytic Geometry**
Au

Catalog Description:

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

Prerequisite:

Course Code L placement and high school calculus experience or permission of the department. Not open to students with credit in 152.

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 out side of class.

Follow-up Course:

Math 162 or H162

Text:

Varies; for example Calculus, by G. Simmons.

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

Topics:

Functions and graphs, limits, continuity, derivatives, applications of derivatives, anti-derivatives, definite integrals, exponential, log, trig and inverse trig functions, techniques of integration, applications of integration.

Course Coordinator:
Daniel Shapiro
R. Solomon (Honors)

Spring, 1989

Mathematics 162* **5 cr.** **Accelerated Calculus and Analytic Geometry**
Wi

*Honors sections will be available and will be taught daily in small sections by faculty members.

Catalog Description:

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. (note: "vectors, lines and planes" appears as part III of the text and is more appropriate for Math 263).

Prerequisite:

Math 161

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.

Follow-up Course:

Math 263

Text:

Continuation of 161 text.

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

Topics:

Sequences and series, power series, Taylor's theorem, convergence tests, vectors, dot and cross product, arclength, space curves.

Course Coordinator:
Daniel Shapiro
Ron Solomon (Honors)

Spring, 1989

Mathematics 187 **2-5 cr.** **Topics in Mathematics**
A

Prerequisite:

Permission of Department.

Catalog Description:

An enrichment course for interested and capable students.

Purpose of Course:

The course is centered around problem solving and methods of approaching problems. There is no fixed course content. Rather, a faculty member offers a course treating topics in which he or she is interested.

H187(honors) may be available to students enrolled in an honors program or by permission of department.

These courses are repeatable to a maximum of 10 credit hours, and are graded S/U.

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Course Coordinator:
Ron Solomon
Spring, 1989

Mathematics	**H190**	**5 cr.**	**Elementary Analysis I**
	H191		**Elementary Analysis II**
	H264*		**Elementary Analysis III**

***Number change from H263(X), effective AU 85.**

A - H190 **W - H191** **SP - H264**

Prerequisite:

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

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, Volume I, Apostol.~~ or Calculus, Spivak (1989-90)

Vector Calculus, 2nd. ed., Marsden and Tromba.

Topics:

H190 - H191: Properties of real numbers. Mathematical induction. Definition of integral. Integrals of polynomials and trigonometric functions. Applications. Continuity, limits, derivatives and applications. Fundamental Theorem of Calculus and integration techniques. Taylor series. Sequences and series of numbers and functions. Uniform convergence. Power series. If time permits, some differential equations or complex-valued functions.

H264: Multivariable calculus (vector approach), gradients, multiple integrals, line and surface integrals, Green's Theorem, divergence theorem, Stokes' Theorem.

Course Coordinator:
Ron Solomon

Summer, 1989

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Mathematics 254 **Au, Wi, Sp, Su**	**5 cr.**	**Calculus and** **Analytic Geometry**

NOTE: The following syllabus takes effect in Winter, 1990. See the previous edition of the course syllabi book for the previous syllabus.

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, 2nd edition, Edwards & Penney.
Chapters 15, 16, and 17

Topics List

Functions of several variables
limits and continuity
partial derivatives
chain rule
directional derivatives
gradient
tangent plane and differentials
extreme values
Lagrange multipliers
double integrals and evaluation
polar coordinates
surface area in triple integrals
triple integrals in cylindrical coordinates
triple integrals in spherical coordinates
moments and center of gravity
change of variables in multiple integrals
vector fields
line integrals
Green's Theorem
surface integrals
Divergence Theorem
Stokes' Theorem

Course Coordinator:
Ted Scheick
Summer, 1989

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Mathematics 255 | **5 cr** | **Differential Equations and Their Applications**
A, W, Sp, Su

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:

Fundamentals of Differential Equations, by Kent Nagle and Edward Saff.; Chapters 1, 2, 3, 4, 6, 7, 8

Suggested Syllabus

	Approximate Number of Days Format	
Chapters:	**Lec./Rec. format**	**Daily Classes**
1. Select material from Sec. 1.1, 1.2, 1.3	1/2	1
2. Select material from Sec. 2.1-2.4 and 2.6	3 1/2	4
3. Select material from Sec. 3.2, 3.3 and 3.5	--	3
4. & 6. " " " " " 4.2-4.10 and 6.2-6.5 (It's a good idea to combine these chapters)	12-14	14
SUGGESTED TEST I: BEGINNING OF 3RD WEEK OF CLASSES		
SUGGESTED TEST II: SIXTH WEEK OF CLASSES		
8. Select material from Sec. 8.2-8.7 and 8.8 (Lec./rec. will not have enough time to cover all)	8	12
SUGGESTED TEST III: TAKE HOME IS APPROPRIATE FOR POWER SERIES SOL.		
7. Select material from: 7.1-7.7 (if time permits)	4	8

REMARK: If time permits, do some sections from Chapter 9.

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For further information see:
Zita Divis
Summer, 1989

Mathematics 263* **5 cr.** **Accelerated Calculus and Analytic Geometry**
Sp

*Honors sections will be available and will be taught daily in small sections by faculty members.

Catalog Description:

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

Prerequisite:

Math 162, H191, or written permission of the department.

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.

Follow-up Course:

Math H520 or other course in differential equations or linear algebra.

Text:

Continuation of 162 text

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

Topics:

Vectors, parametric equations, surfaces, cylindrical and spherical coordinates, partial derivatives, multiple integrals, line integrals, vector fields, Green's theorem, Divergence theorem, Stokes' theorem.

Course Coordinator:
Daniel Shapiro
Ron Solomon (Honors)

Spring, 1989

DEPARTMENT OF MATHEMATICS
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Mathematics 345 | **4 cr.** | **Foundations of Higher Mathematics**
A, Sp

Prerequisite:

Mathematics 254.

Catalog Description:

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

Purpose of Course:

The intention of Math 345 is to build a solid foundation in those topics generally assumed, or only lightly touched upon, in advanced mathematics courses. It is a transitional course intended to follow calculus (254) and precede advanced calculus (547), abstract algebra (580), linear algebra (568), and/or topology (560).

Our 100 and 200 level math courses are basically designed to teach the tool aspect of algebra, geometry, and calculus, whereas in the 500 level mathematics courses it is important that the student be familiar with the concepts of proof and generalization. Some students are not ready to handle the abstraction of these courses without a preliminary introduction to the nature of the mathematical proof.

Text:

The Foundations of Mathematics, Stewart and Tall.

Topics:

1. Introduction to logic, including proof techniques: indirect proof, direct proof, mathematical induction.
2. Basic set theory, function, equivalence relations.
3. Elementary number theory.
4. Integers and their properties.
5. Real numbers including a proof of the Archimedian principle.
6. Transfinite numbers.

Course Coordinator:
Robert Gold

Summer, 1989

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

Prerequisite:

Mathematics 153. Not open to students with credit for 576.

Catalog Description:

Mathematical formalization and reasoning, mathematical induction, sets, mappings, binary relations, binary operations, Boolean algebra, logic; elementary counting principles; graphs.

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.

Follow-up Course:

Math 566.

Text:

To be changed - new text not yet selected.

Topics:

I. Foundations
   A. Sets, products
   B. Relations, functions, operations
   C. Fundamentals of logic
   D. Mathematical induction

II. Combinatorics
   A. Counting principles
   B. Permutations, combinations
   C. Binomial coefficients

III. Relations and Digraphs
   A. Properties of binary relations
   B. Equivalence relations
   C. Operations on relations
   D. Digraphs & adjacency matrices

IV. Graphs
   A. Paths, circuits
   B. Isomorphisms
   C. Trees
   D. Spanning trees
   E. Rooted trees

V. Boolean Algebras
   A. Boolean algebras
   B. Boolean functions

Course Coordinator:
Tom Dowling

Spring, 1989

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Mathematics 415
A, W, Sp, Su

5 cr.

Ordinary and Partial Differential Equations

Prerequisite:

Mathematics 254

Catalog Description:

Ordinary differential equations, separation of variables for partial differential equations, Fourier series, boundary value problems, eigenvalue theory, and Bessel functions.

Purpose of Course:

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

Text:

Elementary Differential Equations and Boundary Value Problems, 4th edition, Boyce and DiPrima.

Topics:	Days Spent
1.1, 1.2, 2.1 - 2.10 - First Order Differential Equations	7
3.1 - 3.62 - Second Order Differential Equations	10
4.1 - 4.7 - Series Solutions of Second Order	10
10.1 - 10.8 - Partial Differential Equations and Fourier Series	13
11.1 - 11.6 - Boundary Value Problems and Sturm-Liouville Theory	5
Optional Material	3 - 5

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Course Coordinator:
Frank Carroll
Spring, 1989

Mathematics 416 **5 cr.** **Vector Analysis and Complex Variables**
Au

Prerequisite:

Mathematics 254

Catalog Description:

Vector algebra and vector operators, line integrals, analytic functions, complex integral theorems, power series, residues, and conformal mapping.

Purpose of Course:

The course is required in Aeronautical and Astronautical Engineering. Minimal proofs or intuitive explanations should be the rule (e.g., Cauchy Theorem by Green's Theorem rather than Cauchy-Goursat). The vector analysis portion should be covered first. This course is a combination of 513 (vector calculus) and 514 (complex variables).

Texts:

Complex Variables, Churchill, Brown, 1984.
Chapters 1 - 7

Schaum's Outline: Vector Analysis.
Chapters 1 - 6

Topics List

Comment -- Use first 3 weeks of quarter for vector analysis. Line integrals and Green's Theorem needed for complex variables. Gauss and Stokes Theorems needed for engineering courses taken concurrently. Run as a problem course. Minimal proofs.

Schedule: Vector Analysis		Number of Classes
Chap. 1 - 4	Vectors, Dot and Cross Product, Vector Differentiation -- treat as review	4
Chap. 5	Vector Integration, including independence of path	5
Chap. 6	Divergence Theorem, Gauss, Green, Stokes Theorems. Omit p. 107.	5

Schedule: Complex Variables		Number of Classes
Chap. 1	Complex Numbers	3
Chap. 2	Analytic Functions	4
Chap. 3	Elementary Functions	4
	Test	
Chap. 4	Mapping by Elementary Functions	5
Chap. 5	Integrals	5
Chap. 6	Power Series	4
	Test	
Chap. 7	Residues and Poles	6

Course Coordinator:
Herb Walum

Spring, 1989

Mathematics 471 **5 cr.** **Matrices and Linear Algebra**
Wi

Prerequisite:

Mathematics 153; not open to students with credit for 568, 571, or 576.

Catalog Description:

Matrices, systems of equations, $\mathbb{R}_n$, determinants; vector spaces; applications.

Purpose of Course:

The purpose of the course is to provide an elementary introduction to the concepts, vocabulary, notation, and results of matrix and linear algebra. It does not contain the depth of material of H520, 568, 569 or 571. Further, emphasis is placed on the topics as tools rather than as development of structure; 4 - 5 weeks are devoted to linear programming.

Text:

To be determined. Handouts by Wyman and Childress are often used.

Linear Programming, Chvatal, Vasek, was used in 1984-85.

Elementary Linear Programming with Applications, Kolman, was used in 1986-87.

Topics:

Matrices -- arithmetic, inverse, transpose, rank;

Systems of equations -- homogeneous and nonhomogeneous;

Vector spaces -- $\mathbb{R}_n$, independence, spanning sets, basis;

Convex sets, basic feasible solutions, extreme points

Linear Programming

Course Coordinator:
William McWorter

Spring, 1989

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Mathematics H487 **2 cr.** **Advanced Problem Solving**
Au

Prerequisite:

Permission of Department.

Catalog Description:

An advanced enrichment course for interested and capable students.

Purpose of Course:

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

Course Coordinator:
Ron Solomon

Spring, 1987

DEPARTMENT OF MATHEMATICS
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Mathematics	501	4 cr. each	Fundamentals of Mathematics I
	502		Fundamentals of Mathematics II
	503		Fundamentals of Mathematics III

A -- 501 W -- 502 Sp -- 503

This sequence will not be offered during 1989-90

Prerequisite:

Written permission of department.

Catalog Description:

The integrated sequence 501, 502, and 503 covers the calculus of one and several variables.

Purpose of Course:

This sequence is intended for graduate students in areas other than the mathematical and physical sciences. These courses are graded S/U.

Topics:

This is an integrated sequence in calculus, with topics from algebra and analytic geometry introduced as needed. The course content is essentially the same as the mathematics sequence 151, 152, 153 and 254, with the exception that some of the theory is deleted and the emphasis is on applications to statistics, economics and social sciences.

Content includes lines, slopes, limits, derivatives, applications of derivatives to curve sketching, maxima and minima, approximations; antidifferentiation, the definite integral, Fundamental Theorem of Calculus; area, volume, other applications of integration; logarithmic, exponential, trigonometric and inverse trigonometric functions; integration techniques; indeterminate forms; improper integrals; Taylor's formula; infinite series; differential calculus of functions of several variables; multiple integration.

NOTE: 502 and 503 will not be offered during 1989-90. The department intends to withdraw these courses in the near future.

Course Coordinator:
Joe Ferrar

Spring, 1989

Mathematics 501S **4 cr.** **General Mathematics Review for Students of Actuarial Science**
W -- Saturdays

Prerequisite:

Permission of department.

Purpose of Course:

The specific topics chosen for this course are those covered on the general mathematics examination (the first examination) of the Society of Actuaries. The course will refine skills already acquired in mathematics courses covering the topics listed.

IT SHOULD NOT BE TAKEN BY ANYONE JUST BEGINNING THE STUDY OF CALCULUS OR LINEAR ALGEBRA.

Topics:

real and complex numbers;
elementary set theory, including unions, intersections, and complements;
functions, equations and inequalities;
analytic geometry of two and three dimensions;
standard algebraic and transcendental functions;
limits, continuity, differentiability, and integrability;
derivatives, integrals, and partial derivatives;
the Fundamental Theorem of Calculus;
applications of derivatives and integrals, including multiple integrals;
finite and infinite sequences and series, including Taylor series;
the mean value theorem;
linear equations, vector spaces, generating sets;
bases and dimension;
subspaces;
scalar products;
linear transformations;
kernel and image space;
matrices;
determinants;
eigenvectors and eigenvalues.

Course Coordinator:
Robert Brown

Spring, 1989

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Mathematics 504 **5 cr.** **History of Mathematics**
Sp

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 purpose of this course is to expose the students to the good mathematics of yesteryear. Also, an attempt is made to place the evolution of mathematics in a historical setting.

Texts:

An Introduction to the History of Mathematics, 4th edition, Howard Eves, (Holt, Rinehart and Winston).
A History of Mathematics, Carl B. Boyer, (Wiley).
The Historical Development of Calculus, C. H. Edwards, Jr., (Springer).

Topics:

(Note: * means that this must be included in the course.)

1. *Reading:
   (1) Eves or some other general history on mathematics
   (2) at least two books of Euclid's Elements

2. *Term paper: This paper is to be at least 80% mathematics and the rest history. The purpose of the paper is to have the student dig in and learn a certain portion of mathematics well, and then present it.

3. Lecture topics (most probable): at least one will be explored thoroughly:
   counting and the abacus
   general solution of the polynomial equation
   irrational numbers
   astronomy and its effect on the development of math
   Cantor theory
   conic sections
   calculus
   the parallel postulate and non-Euclidean geometry
   Euclid's Elements
   axiomatics
   Boolean algebra

4. Other outside reading: there are many good sources

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Course Coordinator:
Tom Schwartzbauer

Spring, 1989

Mathematics 507 **5 cr.** **Advanced Geometry**
A, W
(507N - Autumn quarter only)

Prerequisite:

Mathematics 152

Catalog Description:

Advanced topics from Euclidean Geometry.

Purpose of Course:

To review and clarify high school geometry, and to introduce some advanced topics as extensions of elementary Euclidean geometry.

Topics:

1. Review of high school geometry.
2. Euclidean motions, similarities and affine transformations.
3. Circular inversion or finite geometries (optional).

Course Coordinator:
Joe Ferrar

Spring, 1989

Mathematics 510.01 510.02 510.03 **2-5 cr.** **Topics in Mathematics for Elementary School Teachers**

A, W, Sp, Su

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.

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Course Coordinator:
Jim Leitzel

Spring, 1989

Mathematics 512 | **3 cr.** | **Partial Differential Equations and Boundary Value Problems**

A, W, Sp, Su (1st Term)

Prerequisite:

Mathematics 255 or 415 or 556.

Catalog Description:

Among the topics considered are: Fourier series, orthogonality relations, vibrating string, steady state heat, Laplace transform, and applications.

Purpose of Course:

This three hour course covers a lot of material with little emphasis on theory. A detailed outline based on the following texts is available and should be followed.

Derivation of the partial differential equations of vibrating string, transmission lines, etc., is not expected. Solutions of these equations and interpretation of the solutions is expected.

Texts:

Advanced Engineering Mathematics, 6th ed., Kreyszig, (Wiley).

These books contain most of the material needed, and much more. They are good reference books for engineers to own, especially if they intend to take further mathematics courses. They can also be used for 513 and 514.

Topics:

Fourier series.

Separation of variables and linear partial differential equations.

Laplace transform: definition and elementary properties.

Applications to ordinary linear differential equations.

Topics List

Categories 1, 2, 3 MUST be covered

1. Fourier Series: 8 days including a test.

Trigonometric and Fourier series. Convergence theorem. Even and odd functions and extensions of functions. Half range expansions. Other topics may be included if you have time, e.g., complex Fourier series, double Fourier series.

Kreyszig: Chap. 10, Sections 10.1 - 10.5, 10.7. (10.8 optional.)

2. Partial Differential Equations: 8 days including a test.

Boundary value problems are to be considered for: one dimensional wave equation (series and D'Alembert solution); one dimensional diffusion equations; and Laplace's equation in the plane. The method of separation of variables is used. The differential equations need not be derived. Do many examples of each type. No use of Bessel functions.

Kreyszig: Chap. 11, Sections 11.1, 11.3 - 11.5. (Skimpy on Laplace's equation.)

3. Laplace Transform: 9 days including a test. <u>THIS SECTION MUST BE COVERED WELL</u> for the Chemical Engineers.

Basic properties of the Laplace transform. Existence theorem (stated). Transform of derivatives. Partial fractions. Inverse transform. Solution of ordinary linear differential equations with constant coefficients. Transforms of periodic functions. The "Second Shifting Theorem" and applications. Systems of differential equations and Convolution formula, if time allows.

Kreyszig: Chap. 5, Sections 5.1 - 5.8.

4. Application of Laplace transform to solving partial differential equations or other topics you feel are interesting or important: 3 days. This will depend on the text you use.

Course Coordinator:
Ted Scheick

Spring, 1989

Mathematics 513 **3 cr.** **Vector Analysis for Engineers**
Wi

Prerequisite:

Mathematics 254

Catalog Description:

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

Purpose of Course:

A "skills" course designed to give familiarity with vector notations, vector operations, line and surface integrals. Ample class time should be devoted to problems.

Texts:

Schaum's: Vector Analysis, and
Vector Calculus, Lindgren, or
Div, Grad, Curl and All That, Schey, or
Advanced Engineering Mathematics, Kreyszig, (chaps. 7 and 8).

(Kreyszig is also a good reference book for engineers. It can also be used for 512, 514.)

Topics List

From Lindgren: level of text is about right. Supplementary problems (e.g., Schaums's: Vector Calculus) will be needed.

	Days
Chap. 1 -- Vector algebra, geometry, operations, (As this is review, more time produces less interest.)	3
Chap. 2 -- Vector functions of one variable, space curves, arc length. Parametrization of curves is difficult.	6
Chap. 4 -- Vector functions of position, chain rule, surfaces, del operator, line and surface integrals Parametrization of surfaces.	10
Chap. 5 -- Integral theorems: Gauss, Green, Stokes; path independence.	7

Course Coordinator:
Ted Scheick

Spring, 1989

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Mathematics 514 **3 cr.** **Complex Variables for Engineers**
Sp

Prerequisite:

Mathematics 254

Catalog Description:

Introduction to complex variables, analytic functions, complex integral theorems, power series, residues, conformal mapping.

Purpose of Course:

This is a "skills" course. Subject matter is needed in Engineering courses. Some time on line integrals may be saved, and Green's Theorem may be used to get the Cauchy integral theorem, since these topics have been covered in Math 254.

Text:

Complex Variables and Applications, Churchill, or

Advanced Engineering Math, Kreyszig, or

Elementary Complex Variables, Smith, (Merrill).

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. These students want the text for reference and the lectures to make the text understandable.

Topics List

Syllabus Based on Churchill:	Days
1. Complex numbers, polar form	3
2. Analyticity, Cauchy-Riemann equations	3
3. Elementary functions	4
TEST	
4. Mapping by elementary functions	3
5. Cauchy integral theorem and consequences	5
TEST	
6. Power series	3
7. Residues, definite integrals	6

Syllabus based on Kreyszig: (2 tests and a final exam)

1. Complex analytic functions	9
2. Conformal mapping (omit 12.6)	4
3. Complex integrals	5
4. Sequences, series (just state definitions and the1/2theorems on power series.)	
5. Taylor and Laurent series	2 1/2
6. Integration by residues	6

7. Complex functions and potential theory: only if you have some time left over and the students are well-versed with the above material.

Course Coordinator:
Ted Scheick

Spring, 1989

Mathematics	**H520** **H521** **H522**	**5 cr. each**	**Linear Algebra** **Differential Equations** **Complex Analysis**

A - H520 **W - H521** **Sp - H522**

Prerequisite:

H520 H 263 with a grade of C or better or H 264 with a grade of C or better, or written permission of Honors Committee chairperson. Not open to students with credit for H290.

H521 H 520 with a grade of C or better or written permission of Honors Committee chairperson. Not open to students with credit for H291

H522 H 521 with a grade of C or better or written permission of Honors Committee chairperson. Not open to students with credit for H292

Catalog Description For H520: (number change from H290) Aut 89

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

Catalog Description For H521: (number change from H291)

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

Catalog Description For H522: (number change from H292)

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 comprises the second year of the honors program in mathematics. It is designed to challenge talented, highly motivated students, regardless of their chosen major area of study. This sequence substitutes for Math 568 and 569, Math 255, 256, or 415, and Math 552. It is taught by faculty members in small sections with considerable teacher-student interaction.

Texts vary, for example:

Strang, Linear Algebra and Its Applications
Simmons, Differential Equations with Applications and Historical Notes
Marsden and Hoffman, Basic Complex Analysis, 2nd Edition

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Course Coordinator:
Ron Solomon
Spring, 1989

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

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 involve the student with the dfoundations of modern probability thoery, and in the process, to strengthen his/her understanding of mathematical analysis by its use in probability theory.

Follow-up Course

Math 531

Text:

Elementary Probability Theory with Stochastic Processes, K.L. Chung. Chapters 1-6.

Topics:

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

Course Coordinator:
Louis Sucheston

Summer, 1989

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Mathematics 531 **3 cr.** **Probability II**
Wi

Prerequisite:

Mathematics 530 or Statistics 520

Catalog Description:

Markov chains, classification of states and chains, stationary distributions, random walks, simple stochastic processes, Poisson process, birth and death processes, applications to genetics, diffusion, and queuing theory.

Purpose of Course:

To deepen and broaden the student's probability expertise through work in the specific areas of Markov chains and simple stochastic processes.

Follow-up Course:

Before taking further probability theory, a student will need Math 651-653.

Text:

Elementary Probability Theory with Stochastic Processes, K.L. Chung, Chapters 7 and 8.

Topics:

Further limit theorems, Markov chains and other stochastic processes. Additional topics.

Course Coordinator:
Louis Sucheston

Summer, 1989

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

Prerequisite

Mathematics H290, or H263 and 569, or permission of the instructor

Catalog Description

Introduction to convex sets in E^n, some point set topology in E^n, (including compactness and connectedness properties of subsets of E^n), differentiation of vector valued functions of several variables, relative extrema, the inverse and implicit function theorems, and an introduction to Lebesque integration in 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 E^n 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

Wendell Fleming, Functions of Several Variables, Springer-Verlag, 1977.

Course Coordinator:

Joe Rosenblatt
Autumn, 1988

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

Prerequisite

Mathematics 540, or permission of the instructor

Catalog Description

Review and complete the discussion of Lebesque integration in E^n, and then cover change of variables theorems in E^n, differentiation of parametrized integrals, curves in E^n differential 1-forms, line integrals, the exterior algebra and differential calculus in 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 E^n 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

Wendell Fleming, Functions of Several Variables, Springer-Verlag, 1977.

Course Coordinator:

Joe Rosenblatt
Autumn, 1988

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Mathematics 547 **3 cr.** **Introductory Analysis I**
A, W

Prerequisite:

Mathematics 254.

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:

K. G. Binmore: Mathematical Analysis, 2nd Edition
I. Hirschman: Infinite Series
Schaum: Advanced Calculus

Topics:

The following should not be regarded as a list of topics which must be covered, but rather should convey the spirit of presentation in the course.

1. Precise definitions of continuity, derivative, Riemann integral, improper integral; introduce o, O, ~ symbols.

2. Precise statements and proofs of basic theorems of calculus including Chain Rule, Mean Value Theorem, Fundamental Theorem of Calculus and Taylor's Formula with Remainder in both integral and asymptotic form i.e. as $o[(x-a)^n]$

3. Without proof: Limit theorems; properties of integral; Monotone Convergence Principle; Cauchy's General Principle of Convergence; Intermediate Value Property of Continuous Functions; Existence of maximum.

4. Stress exercises in constructing simple counterexamples (e.g. function tending to $+\infty$ but not monotone on any interval $(a, +\infty)$; $f' > 0$ on its domain and f not increasing on its domain, etc.)

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For further, and more current information, contact:
Frank Carroll
Summer, 1989

Mathematics 548 **3 cr.** **Introductory Analysis II**
W, Sp

Prerequisite:

Mathematics 547

Catalog Description:

Continuation of 547

Purpose of Course:

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

Follow-up Course:

Math 549 or 551 or 552.

Text:

K. G. Binmore: Mathematical Analysis, 2nd Edition
I. Hirschman: Infinite Series
Schaum: Advanced Calculus

Topics:

548 is a continuation of 547 including the following topics:

$\varepsilon - \delta$ definition of limit; numerical and functional sequences and series; uniform convergence, improper integrals

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For further, and more current information, contact:
Frank Carroll
Summer, 1989

Mathematics 549 **3 cr.** **Introductory Analysis III**
Sp

Prerequisite:

Mathematics 548.

Catalog Description:

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

Purpose of Course:

547, 548, 549 is a sequence designed to develop analytic intuition and proof skills. Student participation is emphasized. 549 is a continuation of 548. After completion of 548 the student is ready to begin the study of the calculus of several variables.

Text:

K. G. Binmore: Mathematical Analysis, 2nd Edition
I. Hirschman: Infinite Series
Schaum: Advanced Calculus

Topics:

Study of the role of uniform convergence in analysis.

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For further, and more current information, contact:
Frank Carroll
Summer, 1989

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:

Advanced Calculus, 2nd ed., Wilfred Kaplan.
With supporting problems from Schaum's.

or

Introduction to Vector Analysis, 4th Ed., Harry F. Daris, Arthur David Snider

or

Vector Calculus, 3rd Edition, T.E. Marsden and A. J. Tromba.

Topics:

Vector operations in three dimensions, vector operators, line integrals, surface integrals, volume integrals. The theorems of Green, Gauss, and Stokes. Applications.

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Course Coordinator:
Monique Vuilleumier
Spring, 1989

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

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. 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:

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.

Course Coordinator:
Monique Vuilleumier
Spring, 1988

Mathematics 556 **3 cr.** **Differential Equations I**
W

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, and to develop qualitative and computational concepts and tools.

Text:

1) Ross: Differential Equations or,

2) Ian Huntley and R.M. Johnson: Linear and Nonlinear Differential Equations, supplementary material from e.g. Hildebrand: Advanced Calculus for Applications, Prentice Hall, or

3) David Powers: Elementary Differential Euqations with Boundary Value Problems

Topics: (Using Ross)
1. Systems of Linear Differential Equations (7.1 - 7.3, 7.5 - 7.7, 11.1 - 11.4; about 4 weeks)
2. Non-linear Equations (Ch. 13; about 4 weeks)
3. Topics chosen from:
    (i) Matrix exponentials (handout)
    (ii) Existence and Uniqueness (Ch. 10)
    (iii) Numerical methods (Ch. 8)

Topics: (Using Huntley and Johnson)
1. Systems of linear differential equations (about 3 weeks - Part I in the book)
2. Existence and uniqueness (about 1-2 weeks)
3. Qualitative theory (about 4 weeks - Part II & chapter 9 of Part III in the book)
4. Numerical methods (about 1 week)

For topics #2 and #4, supplementary material may be needed.

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Course Coordinator:
A. Sinha

Spring, 1989

Mathematics 557 **3 cr.** **Differential Equations II**
Sp

Prerequisite:

Mathematics 556

Catalog Description:

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

Course Objectives:

An introduction to PDE's and boundary value problems.

Possible Text:

D. Powers: Boundary Value Problems, or

Haberman: Elementary Applied Partial Differential Equations

Topics: (Using Powers)

1. Fourier Series (1.1 - 1.6) (about 2 weeks)

2. Heat Equation (Includes Sturm-Liouville theory; 2.1-2.9; about 2.5 to 3 weeks)

3. Wave Equation (3.2 - 3.5; about 1.5 weeks)

4. Laplace equation (4.1 - 4.5; about 1.5 weeks)

5. Problems in several dimensions (5.3 - 5.7; about 2 weeks)

6. If time permits additional topics can be chosen from 1.7, 1.9, 1.10, 1.11, 2.9-11, 3.6, Ch. 6, 7 or more detailed discussion of Sturm-Liouville problems or classification of partial differential equation (4.5) or Green's functions.

(The same material is in chapters 1 - 6 of Haberman.)

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Course Coordinator:
A. Sinha

Spring, 1989

Mathematics 558 **3 cr.** **Differential Geometry of Curves and Surfaces**
Wi

Prerequisite:

Mathematics H292, or H522, or 568 and 547 or 551.

Catalog Description:

Introduction to the classical differential geometry of curves and surfaces, both in its local and global aspects.

Purpose of Course:

To provide a senior year option for honors students and simultaneously a differential geometry course below the 800 level for students of mathematics, science, and engineering.

Text:

Differential Geometry of Curves and Surfaces, Manfredo P. de Carmo, (Prentice-Hall InC. , Englewood Cliffs, N.J.)

Topics:

I.Curves (2 weeks)

A. Parametrized curves(2 weeks)
B. Regular curves; arc length
C. The vector product
D. The parametrization by arc length
E. Global properties of plane curves

II.Surfaces (3 weeks)

A. Regular surface
B. Inverse images of regular values
C. Change of parameters and differentiable functions on surfaces
D. The tangent plane, the differential of a map
E. The First Fundamental Form; Area

III.The Gauss normal map

A. Definition and basic properties
B. The Gauss map in local coordinates
C. Ruled surfaces

IV.Intrinsic geometric properties (3weeks)

A. Isometrics; conformal maps
B. Theorema Egreuium
C. Parallel transport; geodesics
D. The Gauss-Bonnet theorem and applications

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Course Coordinator:
Joe Rosenblatt

Spring, 1989

Mathematics 560 | 4 cr. | Point-set Topology
Sp

Prerequisite:

Mathematics 254.

Catalog Description:

Sets and functions, metric spaces, topological spaces, subspaces, limits, closure, interior, sequences, convergence, separate axioms, continuity, connectedness, compactness, product spaces, Euclidean spaces.

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:

Undergraduate Topology, Kasriel, or

Elementary General Topology, Moore, or

Elementary Topology, Gemignani, or

Foundations of General Topology, Pervin.

Course Coordinator:
Henry Glover

Spring, 1987

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Mathematics 566 **3 cr.** **Discrete Mathematical Structures II**

A, W, Sp, Su (2nd Term)

Prerequisite:

Mathematics 366. Not open to students with credit for 576.

Catalog Description:

Enumeration, inclusion - exclusion, generating functions, recurrence relations graphs, network flows.

Purpose of Course:

Follow-up to Math 366. This course is to be the "abstraction" course for CIS undergraduates preparing to go to graduate school. The desire of the CIS faculty is that it present math in rigorous form and require students to deal with abstract systems.

Text:

To be changed - new text not yet selected.

Topics:

I. Enumeration
   A. Counting combinations and permutations
   B. Multinomial theorem
   C. Inclusion-Exclusion

II. Recurrence Functions
   A. Generating functions
   B. Recurrence Relations
   C. Mathods of solution

III. Graphs
   A. Planar graphs
   B. Eulerian and Hamiltonian graphs
   C. Chromatic number

IV. Network Flows
   A. Flows and cuts
   B. Max Flow-Min Cut Theorem
   C. Matching

Course Coordinator:
Tom Dowling

Spring, 1987

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

Prerequisite:

Mathematics 153. 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, notation and results of matrix algebra with interpretations in the space $\mathbb{R}_n$. Emphasis is on techniques, computational skills, and development as algebraic structure.

Follow-up Course:

Math 569.

Text:

An Introduction to Linear Algebra, Johnson and Reiss

Elementary Linear Algebra preliminary edition by McWorter

Chapter 1: sections 1.1 - 1.8 - Matrices and Systems of Linear Equations
Chapter 2: sections 2.1 - 2.6 - The Vector Space $\mathbb{R}_n$
Supplemental notes to replace 3.1 - 3.3 and 3.6 - 3.9 - The Eigenvalue Problem
Chapter 3: section 3.4 - Applications of Eigenvalues
Chapter 5: portions of, if time permits - Determinants

Topics:

1. The space $\mathbb{R}_n$ (addition and scalar multiplication).
2. Subspaces of $\mathbb{R}_n$ (geometric descriptions; independence; spanning sets, basis and dimension).
3. Informal introduction of characteristic roots and vectors.
4. Algebra of matrices (addition, multiplication, transpose, inverses).
5. Determinants and properties (relation to matrix inverses).
6. Systems of equations (homogeneous; non-homogeneous, kernel and image spaces of matrices; rank; nullity, Cramer's rule, Echelon forms).
7. Standard inner product (dot product) in $\mathbb{R}_n$; orthogonality and orthonormal bases.

Suggested additional topics as time permits: further experience with characteristic roots and vectors; other vector spaces over $\mathbb{R}_n$, e.g., the space of matrices, function spaces.

Course Coordinator:
William McWorter

Spring, 1989

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Mathematics 569 **3 cr.** **Introductory Linear Algebra II**
A, W, Sp, Su (2nd Term)

Prerequisites:

Mathematics 568. Not open to students with credit for 572 or 577.

Catalog Description:

Vector spaces over $\mathbb{R}$ and $\mathbb{C}$; linear transformations; the polynomial ring $\mathbb{R}[x]$; characteristic values and vectors; inner product spaces; quadratic form reduction; principal axis theorem.

Purpose of Course:

The purpose of the course is to provide an introduction to vector spaces as an algebraic structure. Relying on the techniques and interpretations established in 568, more emphasis is placed here on abstraction and proof.

Text:

An Introduction to Linear Algebra, Johnson and Reiss.

Chapter 3 or supplemental materials: Review, Eigenvalues
Chapter 3: 3.9, 3.10 (optional): Cayley-Hamilton Theorem
Chapter 4: 4.1 - 4.10: Vector spaces and Linear Transformations
Chapter 2: 2.5; 2.6 optional review prior to 4.6: Orthogonal Bases

May require additional supplementary material.

Topics:

1. Definitions and examples of vector spaces over $\mathbb{R}$ and $\mathbb{C}$ (include $M_{m,n}(\mathbb{R})$ and function spaces).
2. Definition of linear transformations; kernel, image, isomorphisms; dimension relations.
3. Vector space structure of $\mathrm{Hom}_{\mathbb{R}}(V,W)$ and relation to $M_{m,n}(\mathbb{R})$ with choice of bases.
4. Elementary properties of the polynomial rings $\mathbb{R}[x]$, $\mathbb{C}[x]$.
5. Symmetric matrices; inner products and quadratic forms.
6. Principal Axis Theorem (least squares and spectral theory).

For the service aspects of the course (statistics, physics, engineering), the latter two topics are of importance. A fairly thorough treatment of these should be included. If time permits, one could treat canonical forms.

Course Coordinator:
William McWorter

Spring, 1989

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

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:

1. Experiments in Computational Matrix Algebra, David R. Hill
2. Linear Algebra with Applications, S. Leon
3. Matlab disks (provided by the instructor).

Topics List:

The course combines theoretical linear algebra (Leon) with hands-on experience (Hill, and the software package Matlab). Most or all classes will be held in a MacIntosh Lab. Chapters 1-3 and the first half of each of chapters 4 and 5 will be covered from Leon, as well as chapters 1 and 2 of Hill. No programming is required for this course.

Leon:
- Chapter 1 - Matrices and Systems of Equations
- Chapter 2 - Determinants
- Chapter 3 - Vector Spaces
- Chapter 4 - Linear Transformations
- Chapter 5 - Orthogonality
- Chapter 6 - Eigenvalues

Hill:
- Chapter 1 - Beginning to use MATLAB
- Chapter 2 - Linear Systems of Equations

Course Coordinator:
Ed Overman

Summer, 1989

Mathematics 572
A, Sp, 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:

1. Experiments in Computational Matrix Algebra, David R. Hill
2. Linear Algebra with Applications, S. Leon
3. Matlab disks (provided by the instructor).

Topics List:

This is a continuation of 571. Chapters 4 and 5 of Leon's book will be completed, and Chapter 6 covered. Chapter 3 of Hill will be covered. There will be additional selected applications from Hill.

Leon:
Chapter 4 - Linear Transformations
Chapter 5 - Orthogonality
Chapter 6 - Eigenvalues

Hill:
Chapter 3 - Eigenvalues and Eigenvectors

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Course Coordinator:
Edward Overman

Summer, 1989

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 give students an introduction to some ideas in abstract algebra and, more particularly, the discipline of number theory; for students to develop reasonable facility in the formulation of proof.

Text:

An Introduction to the Theory of Numbers, 3rd edition, Niven and Zuckerman.

Topics:

1. Divisibility properties of Z; 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. Extensions and generalizations: polynomial rings over fields; quadratic number fields.

Course Coordinator:
Paul Ponomarev

Spring, 1989

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Mathematics 574 **5 cr.** **Geometry**
Sp of even numbered years

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.

Purpose of Course:

To strengthen geometric intuition, to stress geometric aspects of linear algebra, 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. Klein's model of hyperbolic geometry. Exercises on projective planes over Z mod p.

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Course Coordinator:
Joe Ferrar

Spring, 1989

Mathematics 575 **5 cr.** **Combinatorial Mathematics and Graph Theory**
WI, Sp

Prerequisite:

Mathematics 568.

Catalog Description:

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

Purpose of Course:

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

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

Text:

Introductory Combinatorics, Brualdi

Topics List

1. Basic counting principles: sets, mappings, one-to-one correspondences and cardinality, the rules of sum and product, pigeonhole principle, binomial coefficients.

2. Enumeration theory: inclusion - exclusion principle, recurrence relations, generating functions.

3. Combinatorial designs: Latin squares, finite geometries, difference sets, Steiner triple systems.

4. Matching theory: bipartite graphs, Konig's Theorem, the "Marriage Theorem", the assignment problem.

5. Elementary graph connectivity: paths, connectivity, cycles, cutsets, trees, Eulerian and Hamiltonian paths and circuits.

6. Graph coloring: planar graphs and the Euler formula, Five Color Theorem.

7. Flows in networks: Maxflow-Mincut Theorem, transportation problems, Menger's Theorem.

Course Coordinator:
Tom Dowling

Spring, 1989

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

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:

The search for an appropriate text continues.

References:

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.
6. Network flows and the Ford-Fulkerson algorithm for maximum flow.
7. Additional modeling topics as time and the interests of the instructor permit.

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

Course Coordinator:
Tom Ralley
Summer, 1989

Mathematics 580 **3 cr. each** **Algebra I**
581 **Algebra II**
582 **Algebra III**

A : Math 580
W : Math 581, Math 580N
Sp: Math 582, Math 581N

Prerequisite:

Mathematics 568 (may be taken concurrently with 580.)

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:

This sequence permits students to study topics of number theory, linear algebra, and algebraic structures in a unified and integrated way.

This course does not follow a syllabus. Each instructor can develop the topics according to his or her own preference. When there are two or more sections, instructors are asked to coordinate the content between sections. Instructors are also urged to put heavy emphasis on problem solving.

Text:

Herstein, Abstract Algebra; or Paley and Weichsel; or McCoy.

Topics:

The following list of topics can be regarded as the core of the sequence:

Elementary Number Theory: arithmetic of rational integers, divisibility, primes, Euclidean algorithm, congruences, groups of units; analogous theory in polynomials rings and Gaussian integers.

Elementary Group Theory: permutation groups, dihedral groups, cyclic groups; subgroups, cosets, Lagrange Theorem, normal subgroups, quotient groups, homomorphisms and isomorphisms.

Linear Algebra: independence, basis, subspaces, linear transformations, inner products, orthogonal transformations, matrices and determinants, similarity, systems of linear equations and algorithmic methods of solution, eigenvalues and eigenvectors.

Field Theory: complex numbers, algebraic number fields; finite fields; ruler and compass constructions; field automorphisms.

In addition to the core, one or more of the above areas may be investigated in greater detail. Examples of how this has been done follow. Some of these topics have also been used for added seminars:

Foundations: relations, equivalence relations, order relation, functions and their algebraic properties, transfinite arithmetic.

Elementary Number Theory: linear Diophantine equations, Chinese Remainder Theorem, continued fractions.

Rings and Ideal Theory: Euclidean domains, principal ideal domains, unique factorization domains.

Linear Algebra: quotient spaces, Jordan canonical form, spectral theory, quadratic forms, quadric surfaces in R_2 and R_3, linear programming.

Field Theory: Galois Theory.

Group Theory: Groups acting on sets, orbits and stabilizers, elements of order p, Burnside's counting lemma.

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Course Coordinator:
Daniel Shapiro

Spring, 1989

Mathematics	**H590**	**Au**	**5 cr.**	**Algebraic Structures I**
	H591	**Wi**	**3 cr.**	**Algebraic Structures II**
	H592	**Sp**	**3 cr.**	**Algebraic Structures III**

Prerequisite:

H590-H290 or H520 with grade of C or better or permission of Honors Committee Chairman

H591-H590 with grade of C or better or permission of Honors Committee Chairman

H592-H591 with grade of C or better or permission of Honors Committee Chairman

Catalog Description:

H590:
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.

H591:
A continuation of H 590.

H592:
Continuation of H 591, further topics in group and field theory and their interrelation, Galois theory.

Text:

Topics in Algebra, Herstein.

Suggested Topics List

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, polynomials 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.

Course Coordinator:
Ron Solomon

Summer, 1989

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THE OHIO STATE UNIVERSITY
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Mathematics H594 **3 cr.** **Topics in Mathematics**
Sp

Prerequisite:

Permission of department. Repeatable to a maximum of 10 credit hours.

Catalog Description:

Designed to give groups of advanced undergraduate students an opportunity to pursue special studies not otherwise offered. H594 (honors) may be available to students in an honors program; others by written permission of department.

Purpose of Course:

To present to honors students in mathematics or the sciences several fundamental topics in mathematics that are omitted from the standard course offerings.

Texts:

Normally none.

Topics:

Among many possible topics are: cardinality, the Gamma function, the Riemann zeta function, non-Euclidean geometry, combinatorial topology, the Poincare conjecture, Fermat's "last theorem"

Course Coordinator:
Ron Solomon

Spring, 1989

DEPARTMENT OF MATHEMATICS
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Mathematics 601 **5 cr.** **Mathematical Methods in Science I**

Au

Prerequisite:

Fifteen quarters of mathematics at the 400-500 level or permission of the department. The recommended preliminary courses are 514 and either 513 or 551.

Catalog Description:

Real and complex vector spaces, inner product spaces, linear operators, matrices, eigenvalue problems, normal operators, real and Hermitian forms, applications to physics and engineering.

Purpose of Course:

After this course the students should be able to do all of the 601 questions on the past 5 years of the general exams for engineers and scientists on file in the library.

Many examples are given, using function spaces and complex and real n-space. This is primarily a course in finite dimensional vector spaces.

This is a skills course; the students should do many problems.

Follow-up Courses:

Math 602 and 701.

Text:

No one text is yet satisfactory. References include Hoffman and Kunze, Gelfand, Smirnov, Butkov, Stackgold, Hildebrand and Friedman.

Topics List

1. Real and complex vector spaces, subspaces, linear independence, basis, dimension. Change of basis. Review of solutions of linear (matrix) equations, determinants and matrix inverses.

2. Linear operators, matrix of an operator, change of basis, rank and nullity theorem.

3. Inner product spaces, orthogonal sets, Gram-Schmidt process and the Gram matrix. Examples with weighted inner products in function spaces and in complex n-space. Projection and best approximation in the L2 norm. Examples include overdetermined systems, curve fitting, finite orthogonal (Fourier) expansions, etc. Unitary change of basis, orthogonal complement of a subspace. Examples and applications.

4. Eigenvalues and eigenvectors. Diagonalization of operators. Functions of diagonalizable operators. Application to linear systems of differential equations.

5. Adjoint of an operator with examples in finite and infinite dimensional spaces. Matrix of the adjoint. Normal, Hermitian and unitary operators. Spectral theorem and converse (orthogonal diagonalization of normal operators). Rayleigh quotient and approximation of eigenvectors and eigenvalues (power method). Many examples.

6. Quadratic forms, principal axis theorem (orthonormal diagonalization of a Hermitian form), other methods of diagonalization, Sylvester's theorem, simultaneous diagonalization of quadratic forms.

7. Applications to the theory of small oscillations. Small oscillations with damping, simultaneous diagonalization of commuting Hermitian operators.

The material need not be done in exactly this order.

Pacing:		
	1-2	15 days
	3-4	12 days
	5	10 days
	6-7	13 days

For Further Information See:
Ted Scheick

Spring, 1987

Mathematics 602 | **5 cr.** | **Mathematical Methods in Science II**

Wi

Prerequisite:

Mathematics 601

Catalog Description:

Linear differential equations, solutions about singular points; Sturm-Liouville problems; Bessel functions, Legendre functions; Green's functions; orthogonal expansions; Laplace's equation and boundary value problems.

Purpose of Course:

After 602, the students should be able to do all of the 602 problems on the past 5 years of the general exams for engineers and scientists on file in the library.

Many examples are done. The students should do many problems. This is a skills course.

Follow-up Courses:

Mathematics 701.

Text:

No one text is entirely suitable. References include Stackgold, Friedman, Lebedev, Budak & Samarski & Tikhonov, Duff & Naylor, Byron & Fuller, Butkov, Denneryl & Krzywicki.

Topics List

1. Introduction to Hilbert spaces, norm convergence. complete orthogonal sets. Bessel's inequality and Parseval's identity.

2. Sturm-Liouville operators and the associated weight function, boundary conditions yielding a Hermitian operator, Green's identities. Eigenvalue problems, a-priori estimates of eigenvalues. Orthogonality and completeness of the eigenfunctions. Green's functions for Sturm-Liouville operators, series and closed forms.

3. Boundary conditions making the Laplace operator Hermitian. Green's functions for the Laplacian and related operators (mainly in 2 space dimensions), the eigenvalue problem for these operators. Do more examples in 4, 5.

4. Bessel functions, recursions, identities, generating function, orthogonality, completeness. Many examples using separation of variables on the standard PDE's of physics and engineering.

5. Legendre polynomials recursions, identities, generating function, orthogonality, completeness. Associated Legendre functions (first kind only). Laplace operator in spherical coordinates. Expansions in spherical harmonics. Poisson's formula. Eigenvalues and eigenfunctions of the Laplacian acting on spaces of functions satisfying certain boundary conditions on a sphere. Solve several of the classical PDE's via spherical harmonics by separation of variables.

Remark: One may wish to do the special functions first, and then go into the techniques of separation of variables, orthogonal expansions, and Green's functions with more examples than possible. One should treat non-homogeneous equations to some extent. It is useful to tie things together often with the ideas of 'Hermitian operator', 'eigenvalue problem', and 'expansion via a complete orthogonal set' as unifying themes. Green's functions are best approached using the delta function. Examples should be done in cartesian, polar, cylindrical and spherical coordinates.

Pacing:		
	1.	4 days
	2.	14 days
	3.	6 days
	4.	12 days
	5.	14 days

For Further Information See:
Ted Scheick

Spring, 1987

Mathematics 604 **3 cr.** **Introduction to Continuous Applied Mathematics I**
Au

Prerequisite: Mathematics 255 or 415 or 556.

Catalog Description:

Formulation, solution, and interpretation of selected problems in applied mathemtics: equilibrium, stability, and phase plane analysis (mechanics and ecology); method of characteristics (traffic flow).

Follow-up Courses:

Mathematics 605.

Text:

Haberman (too elementary)
Theory of Oscillations, Andronov-Vitt-Khakin
Hartman
Coddington-Levinson
Differential Equation Models, ed. Braun, Coleman, Drew

Topics List:

The theoretical aspect of this course centers around qualitative phase plane analysis of autonomous systems. Theory one discusses: the vector field, equilibrium points, linearization at equilibrium points and the local behavior of the system near equilibria (local phase portrait), classification of equilibrium points. For the global analysis: orbits and their properties, limit sets, limit cycles, path polygons, separatrices and basins, invariant sets, Poincare-Bendixson theorem, Dulac's test and some results from index theory are discussed. If time permits, Liapunov's theory can be discussed. The importance of first integrals should be mentioned, especially in connection with conservative mechanical or electrical systems and with the interpretation of conservation laws.

Modeling should be done for ecological systems (e.g. predator-prey, competing species), epidemology, and other soft science examples, and these examples should be analyzed with the phase plane theory. Modeling of some mechanical systems should be done, especially nonlinear damped and undamped oscillators (e.g. pendulum, Froude pendulum, hard and soft spring oscillators). Some examples from electrical oscillators can be done. Other classical oscillator ODE's that can be discussed are: Rayleigh, Scott-Murata, Van der Pol and the Duffing equation.

The phenomenon of bifurcation should be discussed and bifurcation diagrams made for some of the examples.

Use of the computer to draw phase portraits is useful as a tool to illustrate the theory and to numerically decide the global behavior of a system in certain cases.

For Further Information See:
Ted Scheick

Summer, 1989

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Mathematics 605 **3 cr.** **Introduction to Continuous Applied Mathematics II**
Wi

Prerequisite:

Mathematics 604 and 651.

Catalog Description:

Elementary partial differential equations of mathematical physics (heat, wave, and Laplace's equations); separation of variables, Fourier series, Sturm-Liouville boundary value problems.

Text:

Applied Elementary P.D.E., Haberman. References include: Budak et. al., Levedev, Samarskii, Butkov, Street, and others along these lines.

Topics List:

These equations are derived from some physical models, and internal sources are included in the derivation. The physical meanings of the 3 kinds of boundary conditions are also discussed. The homogeneous equations are solved by separation of variables. Systems with nonhomogeneous differential equations or nonhomogeneous boundary conditions are solved by the eigenfunction method.

Sturm-Liouville theory, complete othogonal sets (of eigenfunctions), and convergence in the sense of a weighted L2 norm are discussed. Pointwise convergence and estimates for uniform convergence are done to some extent in specific cases.

Interpretation of the mathematical solution in the context of the physical problem is stressed.

If time allows, some work on Green's functions should be included.

The work is principally done in rectangular coordinates (1, 2, 3 dimensions) and in polar coordinates. Little use is made of special functions, unless time allows.

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For Further Information See:
Ted Scheick

Summer, 1989

Mathematics 606 **3 cr.** **Introduction to Numerical Analysis of Partial Differential Equations**

Sp

Prerequisite:

Mathematics 568, and either 602 or 605.

Catalog Description:

Finite difference methods for ordinary and partial differential equations, interpolation of data, introduction to finite element methods, stability, convergence, error estimates.

Text:

Numerical Solution of Partial Differential Equations, G. D. Smith, or
Digital Computer Treatment of Partial Differential Equations, Vemuri and Karplus, or others

Topics:

1. Classification of PDEs and description of the qualitative aspects of their solution.

2. Finite difference discretizations of derivatives and local discretization errors.

3. Parabolic PDEs: Crank-Nicholson, Dufort-Frankel, Richardson and other 2 and 3 level finite difference methods. Discretization of derivative boundary conditions. Non linear equations. Method of lines. Local and global error, matrix and Von Neumann stability criterion. Tridiagonal matrix solving algorithm. ADI and operator splitting methods in higher dimensions.

4. Elliptic PDEs: finite difference methods, irregular boundaries, derivative boundary conditions, local and global errors. Discussion of Jacobi, Gauss - Seidel, and SOR methods of solving linear systems. The energy method, if time permits.

5. Hyperbolic PDEs: Method of characteristics. Method of lines. Finite difference methods such as Lax - Wendroff, Richtmeyer - Moreton, Lax, Leapfrog and others. CFL condition and stability.

For Further Information See:
Ted Scheick

Spring, 1987

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Mathematics 610.01 1-5 cr. Topics in Mathematics for Teachers
610.02
610.03
610.04
610.25

Su, Au, Wi, Sp

Prerequisite:

One year teaching experience or permission of instructor.

Catalog Description:

Special topics in mathematics for teachers at the secondary level. Each decimal subdivision, except 610.25, repeatable to a maximum of 10 credit hours with written permission of department.

Topics:

610.01 Geometry

610.02 Algebra

610.03 Approximation Methods

610.04 Probability

610.25 Special Projects (1 Cr.)
(Prereq: Enrollment in mathematics MA specialization or written permission of department. This decimal subdivision is graded S/U.)

Audience:

Designed for in-service teachers.

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For Further Information See:
Jim Leitzel

Spring, 1989

Mathematics 611 **4 cr.** **Geometric Linear Algebra**

Prerequisite:

Mathematics 568, and enrollment in Mathematics M.A. specialization.

Catalog Description:

Two and three-dimensional linear algebra over the real numbers; geometric interpretations, both Euclidean and affine.

Text:

Linear Algebra Thru Geometry, Banchoff, (Springer-Verlag)

Core Courses Offered Au 89 - Su 92:

Au 89: 613, 614	Au 90: 613, 615	Au 91: 612
Wi 90: 615	Wi 91: 621	Wi 92: 611, 614
Sp 90: 621	Sp 91: 612, 614	Sp 92: 615
Su 90: 611; 614	Su 91: 613; 615	Su 92: 614, 621

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For Further Information See:
Jim Leitzel

Spring, 1989

Mathematics 612 **4 cr.** **Elementary Geometry from an Advanced Standpoint**

Prerequisite:

Mathematics 507, and enrollment in Mathematics M.A. specialization.

Catalog Description:

Axiomatic development of elementary geometry of plane and space, introduction to non-Euclidean geometry.

Text:

Elementary Geometry from an Advanced Standpoint, E. E. Moise.

Core Courses Offered Au 89 - Su 92:

Au 89: 613, 614	Au 90: 613, 615	Au 91: 612
Wi 90: 615	Wi 91: 621	Wi 92: 611, 614
Sp 90: 621	Sp 91: 612, 614	Sp 92: 615
Su 90: 611; 614	Su 91: 613; 615	Su 92: 614, 621

For Further Information See:
Jim Leitzel

Spring, 1989

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Mathematics 613 **4 cr.** **Number Theory and Algebra**

Prerequisite:

Mathematics 580, and enrollment in Mathematics M.A. specialization. Not open to students with credit for 670.

Catalog Description:

Arithmetic and order properties of the integers, unique factorization, congruence arithmetic, Chinese Remainder Theorem, unit groups; polynomial algebra, roots of unity, non-unique factorization.

Text:

A Concrete Introduction to Higher Algebra, Childs & Porter.

Core Courses Offered Au 89 - Su 92:

Au 89: 613, 614	Au 90: 613, 615	Au 91: 612
Wi 90: 615	Wi 91: 621	Wi 92: 611, 614
Sp 90: 621	Sp 91: 612, 614	Sp 92: 615
Su 90: 611; 614	Su 91: 613; 615	Su 92: 614, 621

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For Further Information See:
Jim Leitzel

Spring, 1989

Mathematics 614 **4 cr.** **Calculus from a Numerical Viewpoint**

Prerequisite:

Mathematics 254, and enrollment in Mathematics M.A. specialization.

Catalog Description:

A review of major concepts and theorems of differential and integral calculus using a numerical approach.

Text:

Numerical Analysis, Burden, Faires & Reynolds.

Core Courses Offered Au 89 - Su 92:

Au 89: 613, 614	Au 90: 613, 615	Au 91: 612
Wi 90: 615	Wi 91: 621	Wi 92: 611, 614
Sp 90: 621	Sp 91: 612, 614	Sp 92: 615
Su 90: 611; 614	Su 91: 613; 615	Su 92: 614, 621

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For Further Information See:
Jim Leitzel

Spring, 1989

Mathematics 615 **4 cr.** **Foundations of Calculus**

Prerequisite:

Mathematics 614, and enrollment in Mathematics M.A. specialization. Not open to students with credit for 651.

Catalog Description:

Real number systems, Dedekind cuts, basic set theory, introductory metric topology, connectedness, limits, continuity, the derivative, properties of differentiable functions, Riemann sums, integration.

Text:

Advanced Calculus, Fulks, or

A First Course in Real Analysis, Rudin

Core Courses Offered Au 89 - Su 92:

Au 89: 613, 614	Au 90: 613, 615	Au 91: 612
Wi 90: 615	Wi 91: 621	Wi 92: 611, 614
Sp 90: 621	Sp 91: 612, 614	Sp 92: 615
Su 90: 611; 614	Su 91: 613; 615	Su 92: 614, 621

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For Further Information See:
Jim Leitzel

Spring, 1989

Mathematics 616 **4 cr.** **Numerical Methods in Actuarial Mathematics**
Au (2 2-hour classes)

Prerequisite:

Mathematics 254, and either 471 or 569; or permission of instructor.

Catalog Description:

Finite differences, difference operators, interpolation, summation, difference equations; applications to actuarial science and finance.

Purpose of Course:

This course is designed to provide students with an introduction to the mathematical topics in numerical analysis which are relevant to actuarial science. The course includes the material on numerical methods in the Associateship Examination of the Society of Actruaries and the Casualty Actuarial Society. The course is required for the undergraduate major in actuarial science.

Text:

Numerical Analysis., Burden, R. L., Faires, J. D., 4th edition, 1989, PWS Publishers.

Topics:

The minimum course content is:

1. Solution of Equations in One Variable
2. Interpolation and Polynomial Approximation
3. Numerical Integration
4. Direct Methods for Solving Linear Systems
5. Discrete Least-Squares Approximation

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For further information see:
Robert Brown

Spring, 1989

Mathematics 618 **3 cr.** **Theory of Interest**
Sp (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:

This course is the first with any specific actuarial content. 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 the associateship examinations of the various actuarial organizations. The course is required for the undergraduate major in actuarial science.

Text:

The Theory of Interest., S. G. Kellison, 1970.

Mathematics of Compound Interest, M. V. Butcher and C. J. Nesbitt, is a useful reference.

Topics:

The minimum course content is:

1. Measurement of interest and discount, compound interest.
2. Force of interest, equations of value.
3. Annuities-certain, continuous annuities, varying annuities.
4. Amortization, numerical calculation of yield rates.
5. Valuation of securities.
6. Measurement of interest on a fund, life insurance settlement options, installment loans.
7. Depreciation, depletion, capitalized cost.

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For further information see:
Robert Brown

Spring, 1989

Mathematics 621 **4 cr.** **Probability**

Prerequisite:

Mathematics 254, and enrollment in Mathematics M.A. specialization.

Catalog Description:

A problem oriented approach to major probability concepts: independence, conditional probabilities, expected values, binomial, normal, and other distributions, law of large numbers.

Core Courses Offered Au 89 - Su 92:

Au 89: 613, 614	Au 90: 613, 615	Au 91: 612
Wi 90: 615	Wi 91: 621	Wi 92: 611, 614
Sp 90: 621	Sp 91: 612, 614	Sp 92: 615
Su 90: 611; 614	Su 91: 613; 615	Su 92: 614, 621

Course Coordinator:
Jim Leitzel

Spring, 1989

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Mathematics 630 **3 cr** **Mathematics of Life Contingencies I**
631 **Mathematics of Life Contingencies II**
632 **Mathematics of Life Contingencies III**

Au: 630 (Two 1 1/4 hour classes)
Wi: 631 (Two 1 1/4 hour classes)
Sp: 632 (Two 1 1/4-hour classes)

Prerequisite:

Mathematics 618, and 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: Continuation of 631; valuation theory for pension plans; insurance models including expenses; nonforfeiture benefits and dividends; topics of interest in life and casulty contingencies.

Purpose of Course:

This course is designed to introduce students to the mathematical content of the theory of contingencies. The course includes the material on life contingencies in the Associateship Examination 150 of the Society of Actruaries. The course is required for the undergraduate major in actuarial science.

Text:

Actuarial Mathematics., Newton L. Bowers, Jr., et al, Society of Actuaries.

The following are useful references:

Life Contingencies, C. W. Jordan
Mortality Table Construction, R. W. Batten
An Introduction to Credibility Theory, L. H. Longley-Cook.
Introduction to Credibility, exposure draft, Casualty Actuarial Society

Topics List

Minimum Course Content:

630
1. Survival Distributions and Life Tables
2. Life Insurance and Life Annuities
3. Net Premiums

631
4. Net Premium Reserves
5. Multiple Life Functions
6. Multiple Decrement Models
7. Valuation Theory for Pension Plans

632
8. Insurance Models including Expenses
9. Nonforfeiture Benefits and Dividends

Special Note:

The minimum course content should be completed by May 1 for the benefit of students preparing for the May actuarial examinations.

For further information see:
Robert Brown

Spring, 1989

Mathematics 634 **4 cr.** **Linear Mathematical Models**
Au, Sp

Prerequisite:

Mathematics 117 or 131 or 151, or permission of department.

Catalog Description:

Linear equations, inequalities, convex sets, matrix algebra, linear programming, duality, applications of linear mathematical models to business, transportation flow, and the social and behavioral sciences.

Purpose of Course:

The general objective of the course is to prepare the student to use linear programming methods to solve management related problems of resourse allocation and product output.

Text:

Linear Programming for Decision Making: An Applications Approach, Anderson, David R., Dennis Sweeney, and Thomas Williams, (West Publishing) or

Linear Programming: An Emphasis on Decision Making, Hughes, Ann and Dennis Grawiog, (Addison-Wesley)

Topics:

I. Introduction to Linear Programming
- Optimization model
- Graphics of LP

II. Computer Programs for Solving LP problems

III. Logic of the Simplex Method
- Basic, feasibible solutions
- Optimality criterion

IV. Infeasibility, Degeneracy, and Alternate Optimal Solutions

V. Duality

VI. Sensitivity, Near-Optimal Analysis, and Post-Optimal Analysis

VII. Model Formulation
- Model structure and model building
- Intermediate products and balance equations
- Integer programming models
- Multiperiod and dynamic models
- Financial and marketing applications
- Distribution and scheduling problems
- Environmental models

For Further Information See:
Bostwick Wyman

Spring, 1987

Mathematics 635 **3 cr.** **Game Theory**
Su

Prerequisite:

Mathematics 568, or permission of department.

Catalog Description:

Concept of a game, mini-max theorem; linear programming.

Text:

The Theory of Games, 2nd edition, Owens.
There are others, but this one works very well.

Topics:

Concept of a game, extensive and normal forms of games, Zermelo's Theorem, mini-max theorem for zero sum games, solution of games by linear programming, the simplex method, bimatrix games, convex sets, cones, fixed point theorems, applications to game theory.

For Further Information See:
J.P. Huneke

Spring, 1987

Mathematics 640 **3 cr.** **Introductory Topology**
Su

Prerequisite:

Mathematics 254; not open to students with credit for 655.

Catalog Description:

The topology of the line, plane, Euclidean n-space, and metric spaces; emphasis on elementary ideas in topology.

Purpose of Course:

Foundation to prepare students for graduate courses in analysis and topology.

Topics

I. Naive Set Theory

Intersection, Union, Complement, DeMorgan's laws, products, coproducts, Universal Mapping properties, relations, equivalence relations generated by a relation.

II. The Real Numbers

Integers, Cauchy sequences, the real numbers as equivalence classes of Cauchy sequences of rational numbers, as the complete ordered field containing.

III. The topology of

Intervals, open sets, closed sets, continuity, compactness, connectedness.

IV. Metric Spaces.

For Further Information See:
Henry Glover

Spring, 1987

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Mathematics 645 **3 Cr.** **Foundations of Higher Mathematics**
Su

Prerequisite: Department permission.

Catalog Description:

Introduction to logic, set theory, and methods of proof; natural numbers, induction, well-ordering, the integers, rationals; cardinality.

Purpose of Course:

Provide a basic understanding of the mathematical formalism encountered in advanced mathematics courses. Serve as prerequisite course for Mathematics Education certification program.

Follow-up Courses: No specific follow-up.

Text:

Set Theory, Pinter; or similar.

Topics:

I. Basic formalisms (with examples from undergraduate topics)

A. Logic
B. Proof

II. Set theoretic concepts

A. Sets
B. Relations
C. Mappings
D. Transformations of a set (e.g. permutations)
E. Composition
F. Binary relations in sets

III. Number systems (constructions and properties)

A. Natural numbers and induction
B. Integers and rationals
C. Real numbers
D. Complex numbers
E. Cardinal numbers

For Further Information See:
Joseph Ferrar

Spring, 1988

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Mathematics 647 **4 cr.** **Set Theory**
Sp

Prerequisite:

Advanced undergraduate sequence (e.g. 547, 548, 549 or 580, 581, 582) or permission of instructor.

Catalog Description:

Axiomatic set theory, transfinite induction and theory of ordinals, order type characterizations, cardinal arithmetic and structure, principles of choice, fundamental infinite combinatoric principles.

Purpose of Course:

To provide a foundation for students expecting to specialize in mathematical logic or set theory (these students should also take 648, 649) as well as introducing basic techniques for dealing with large sets useful in other areas of mathematics.

Text:

Sets: Naive, Axiomatic, & Applied, van Dalen, Doets, & Swart.

Elements of Set Theory, Enderton.

Basic Set Theory, Levy, (only part A would be used.)

For Further Information See:
Tim Carlson

Spring, 1987

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Mathematics 648 | 3 cr. | Mathematical Logic I
649 | | Mathematical Logic II

Au: 648 Wi: 649

Prerequisite:

Advanced undergraduate sequence (e.g. 547, 548, 549 or 580, 581, 582) or permission of instructor.

Catalog Description:

648:

The syntax and semantics of sentential logic and first order logic; completeness and compactness theorems for first order logic.

649:

Continuation of 648; decidability and undecidability of systems and structures for number theory; Godels's incompleteness theorems and recursive functions; second order logic.

Purpose of Course:

To provide a basic introuction to the main areas of amthematical logic except set theory (only a small amount of "naive" set theory is covered). Students intending to specialize in mathematical logic should combine this sequence with 647 (set theory). 649 relies heavily on 648.

Text:

A Mathematical Introduction to Logic, Enderton.

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Topics:

648:

Sentential logic and first order logic. Introduction to effective computability (informal). Basic concepts of model theory: semantic interpretation of first order statements, homomorphisms, Lowenheim-Skolem Theorems (on the size of models of a theory) etc. The main goals are to prove the compactness theorem (if every finite subset of a collection of first order statements is consistent, i.e. not contradictory, then the collection is consistent) and the completeness theorem (every logically valid first order statement has a proof).

649:

The method of elimination of quantifiers and the decidability of certain parts of number theory. Introcution to recursive functions (formal analogue of effectively computable functions) and discussion of solution to Hilbert's 10th problem (there is no algorithm for deciding if a diophantine equation has solutions). Godel's incompleteness theorem (there's no algorithm for deciding if a first order statemnet of number theory is true) and the solution of Hilbert's second problem (impossibility of "finitistically" proving the consistency of small fragments of mathematics).

For Further Information See:
Tim Carlson

Spring, 1987

Mathematics 650 **5 cr.** **Principles of Mathematical Analysis**
Su

Prerequisite: Mathematics 547 or permission of the Graduate Advising Cmm.

Catalog Description:

Riemann-Stieltjes Integral; Uniform Convergence and Interchange of Limit Processes, Special Functions, Fourier Series.

Purpose of Course:

New graduate students in Statistics will form the core of the audience. This group will be supplemented by students from science, engineering, and mathematics. These students need more maturity in mathematical analysis for graduate work in their disciplines. The plan of the course is to work on topics close to application in statistics, and to use feedback from student discussion, board presentations, and exercise sets to determine what advanced calculus material needs special review.

Text: Principles of Mathematical Analysis, (3rd.), by Walter Rudin, McGraw-Hill.

Topics:

Week 1: Definition, existence and properties of the Riemann-Stieltjes integral.

Week 2: Integration of vector-valued functions, rectifiable curves.

Week 3: Discussion of exercises; review of advanced calculus topics as called for, including the Cantor set.

Week 4: Examples illustrating difficulties in interchange of limit processes; uniform convergence. (Test 1)

Week 5: Uniform convergence of sequences of complex valued functions, as related to continuity, integration and differentiation.

Week 6: Discussion of exercises; review of advanced calculus topics, especially continuity.

Week 7: Power series: analytic properties, radius of convergence, including review of less advanced topics.

Week 8: Exponential, logarithmic and trigonometric functions; the gamma function. (Test 2)

Week 9: Complex Fourier series.

Week 10: Discussion of exercises.

The students' grades will be based on the two tests (20% each), the final examination (40%), exercise sets (10%) and classroom presentations (10%).

For Further Information See:
Frank Carroll

Spring, 1989

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

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, Statistics Ph.D. students, Mathematics Ph.D. students with incomplete prerequisites, and a few others. General work on writing proofs, and on analytic intuition.

Follow-up Courses:

Math 722: Theory of Probability I
Math 750: Real Analysis I
Math 767: Introduction to the Theory of Approximation I

Possible Text:

K. Stromberg, An Introduction to Classical Real Analysis
  651: Chapters 2 and 3
  652: Chapters 4, 5 and 7 (except optional sections).
  653: Chapter 6

or:

W. Rudin, Principles of Mathematical Analysis and H. Royden, Real Analysis
  651: Rudin, Chapters 1-5
  652: Rudin, Chapters 6-8
  653: Rudin, Chapter 9, and Royden, parts of Chapters 3, 4, 11 and 12

or:

K. Hoffman, Analysis in Euclidean Space
  651: Chapters 2 and 3
  652: Chapters 4 and 5 (and possibly 6)
  653: Chapters 7 and 8
or equivalent text chosen by the instructor

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For Further Information See:
Gerald Edgar
Spring, 1988

Mathematics 654 | 3 cr. | Complex Variables
Su

Prerequisite:

Permission of dept. Not open to students with credit for 514 or 552.

Catalog Description:

Complex arithmetic, geometry, conformal mapping, analytic functions, and residues.

Purposes of Course:

1.For students to meet and come to know well the elementary analytic functions through their algebraic manipulations but mainly through their mapping properties;
2.To study conformal mappings and their applications;
3.To learn the representations of analytic functions through integrals and series;
4.To master the use of Residue Theory, and to evaluate contour integrals, including contours about branch points.

This course is recommended primarily for graduate students in science, engineering, and mathematics who did not have an undergraduate course in complex variables.

Text:

Instructor's choice. One recent text was:
Fundamentals of Complex Analysis for Mathematics, Science, and Engineering, E.B. Saff and A.D. Snider, (Prentice-Hall).

Topics:

I.First Term	
1.Complex numbers	2 classes
2.Analytic functions	2 classes
3.Elementary functions	2 classes
4.Review and Test I	2 classes
5.Geometry, bilinear transformations	2 classes
6.Schwarz-Christoffel transformations	1 1/2 classes
7.Applications	1 1/2 classes
8.Review and Test II	2 classes
II.Second Term	
1.Complex integration	3 classes
2.Series Representations	3 classes
3.Review and Test III	2 classes
4.Residue Theory	6 classes
5.Review and Test IV	2 classes

For Further Information See:
Frank Carroll

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Spring, 1989

Mathematics 665 | **4 cr. each** | **Modern Mathematical Methods in Relativity Theory I, II**
666

Wi: 665 | **Sp: 666**

Prerequisite:

Mathematics 254 and Physics 133.

Catalog Description:

665:
Geometry in Minkowski space-time; physical interpretations; tensors; exterior calculus; manifolds; Lie derivatives; parallel transport; torsion; curvature; Cartan's two-structural equations; Einstein Field equations; spherical gravitational collapse, their application as an effecient calculation tool.

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

Purpose of Course:

a)To equip the student with those modern mathematical ideas and their related physical concepts which underlie both the special and general theory of relativity and their applications.
b)To provide a set of tools necessary for independent work in analytical and numerical relativity.

Text:

Primarily Gravitation, C. W. Misner, K. S. Thorne, & J. A. Wheeler, and
Space-Time Physics, E. Taylor & J. A. Wheeler

Topics:

665: The principle of realativity and the geometry of Minkowski space-time; tensors; exterior calculus; manifolds; commutators; parallel transport; torsion; curvature; Cartan's two-structural equations; Cartan-Misner calculus; Bianchi identities and the boundary of a boundary; Einstein Field equations; geometrical and hydrodynamical equations for gravitational collapse.

666: Stress-energy tensor; hydrodynamics in flat and curved space-time; Hamilton-Jacobi theory; solutions to the Einstein field equations; geometry and dynamics of homogeneous cosmologies; black holes; vector andf tensor harmonics; gauge invariants; waves in violent relativistic backgrounds.

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Topics List (to be revised)

Math 665:

I. Vector algebra and calculus in space-time. (13 lectures)
   1. Geometry of apce-time (Ch.1 in T & W)
   2. Energy and Momentum (Ch 2 in T & W)
   3. Accelerated Observers (Ch. 6 in M, T, & W)

II. Tensor algebra (13 lectures)
   1. Ch. 2 in M, T & W
   2. Ch. 3 in M, T & W
   3. Ch. 6 in M, T, & W

III. Differential Geometry (13 lectures)
   1. Ch. 9 in M, T & W
   2. Ch. 10 in M, T & W
   3. Ch. 11 in M, T, & W
   4. Ch. 13 in M, T & W
   5. Ch. 14 in M, T & W

666:

I. Relativistic Euler equations of motion
   1. Ch. 5.1 in M, T & W
   2. Ch. 22.1 in M, T & W

II. Einstein's Field equations
   1. Ch. 16.1 - 16.2 in M, T & W
   2. Ch. 17.1 - 17.4 in M, T & W

III. Solutions to the combined Einstein-Euler equaitons and their properties
   1. Ch. 23 in M, T & W

VI. Hamilton-Jacobi theory in the space-time of a black hole.
   1. Ch. 25.1 - 25.6 in M, T & W

V. The Universe: Solutions with isotropic homogeneous sections
   1. Ch. 27.1 - 27.10 in M, T & W

VI. Gravitational Collapse & Black Holes
   1. Ch. 31, 32, 33 in M, T & W
   2. Ch. 34 or 35 (if time permits).

For Further Information See:
Ulrich Gerlach

Spring, 1989

Mathematics 669 **5 cr.** **Introduction to Number Theory**

Su

Prerequisite:

Mathematics 254

Catalog Description:

Basic concepts of divisibility, congruence, reciprocity, and primitive roots as introduction to algebra with emphasis on techniques of proof.

Purposes of Course:

An intense introduction to problem solving: experimentation - conjecture - proof, using the Elementary Theory of Numbers as the vechicle.

In addition to 669, each student is required to enroll in a 4 credit problem seminar.

Text:

No text is completely appropriate.

For Further Information See:
Arnold E. Ross

Spring, 1987

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Mathematics 670 671 672	**5 cr.**	**Algebra I Algebra II Algebra III**
Au: 670	**Wi: 671**	**Sp: 672**

Prerequisite:

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

Catalog Description:

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.

672:
Continuation of 671, orthogonality; quadratic forms, finite fields, various applications, Elementary Galois Theory.

Purpose of Course:

Standard entry for M.S. students in mathematics. Should supply much (but not necessarily all) of the material needed for the Qualifying Master's Examination in Algebra.

Text:

Brown-Wyman mimegraphed notes and/or other texts assigned by the instructor.

Topics List

670: Elementary Number Theory
Introduction to group theory
Groups acting on sets and permutation groups
Sylow theory
Polya counting theory
Intro to rings and ideals

671: Linear Algebra
Vector spaces and linera transformation
Theory of a single endomorphism
(eigenvectors, canonical forms)

672: orthogonality and bilinear forms
Linear Programming
Introduction to Galois Theory

Special topics if time permits.

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For Further Information See:
Bostwick Wyman

Spring, 1989

Mathematics 674 **3 cr.** **Survey of Combinatorial Mathematics**

Su, Sp

Prerequisite:

Mathematics 569

Catalog Description:

Matching and network flows, graph theory, combinatorial designs, and enumberation theory.

Text:

Introductory Combinatorics, Bogart

Topics:

Sets, multisets, and partitions; binomial and multinomial coefficients, principle of inclusion - exclusion, generating functions, elementary graph theory, matching theory, combinatorial designs and network flows.

For Further information See:
Tom Dowling

Spring, 1987

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Mathematics 675	4 cr. each	Applied Discrete Mathematics I
676		Applied Discrete Mathematics II
677		Applied Discrete Mathematics III

Au: 675 Wi: 676 Sp: 677

Prerequisite:

Mathematics 672

Catalog Description:

675:
Graph theory, trees, cycles, coboundaries, electrical networks, network flows, transportation problems, linear programming, integer programming, use of algorithms will be stressed.

676:
Combinatorial designs, applications in experiments, coding theory, computational complexity, enumeration theory with physical applications.

677:
Topics in graph theory, designs, codes, enumeration problems, algorithms and computational complexity.

Purpose of Course:

Required for M.S. students following the applied Discrete Mathematics option.

Text:

675: Applied Combinatorics, Roberts
676: Applied Combinatorics, Roberts
677: Applied Combinatorics, Roberts

Topics:

675:
Basic counting rules; graphs, digraphs, connectivity, colorings, chromatic polynomials, trees, spanning trees, depth-first search, eulerian chains and paths, hamiltonian chains and paths, matchings, covers, alternating chains, minimum weight spanning trees, shortest paths, networks, flows, cuts, angmenting chains.

676:
Discrete probability, counting occupancies, generating functions, recurrence relations, inclusion-exclusion, Polye theory of counting.

677:
Pigeonhole principle, Ramsey theory, latin squares, block designs, finite affine and projective planes, difference sets, error-correcting codes, linear codes, cyclic codes, bounds on codes, BCH codes, Hadamard codes.

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For Further Information See:
Tom Dowling

Spring, 1987

Mathematics 701 **5 cr.** **Mathematical Methods**
Sp **In Science III**

Prerequisite:

Mathematics 601, or permission of department.

Catalog Description:

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

Purpose of Course:

After 701, the students must be able to do all of the 701 problems on the last 5 years of the general exams for engineers and scientists of file in the library.

Many examples are done. The students should do many problems.

Texts:

Weinstock, Gelfand & Fomin, Smith for calculus of variations.

Sokolnikoff for tensors. This is out of print; it is the correct level and is hard to replace.

Topics List

Calculus of Variations

1. The first variation of a functional is computed for many kinds of functionals. The Euler-Lagrange equations are derived, along with various 'natural boundary conditions' for unconstrained ends. The students should know this method along with the formulae.

2. Lagrange multipliers for integral and pointwise constrints.

3. Transversality conditions.

4. Goedesics.

5. Hamiltons equations.

6. Rayleigh-Ritz method of approximating eigenvalues and eigenfunctions of Sturm-Liouville operators.

Tensor Analysis

1. Difinitions, examples, rough idea of 'manifold', algebraic laws, quotient theorem.

2. Metric Tensor, Christoffel symbols, covariant derivative intrinsic derivative. Classical differential operators in tensor notation. Examples on surfaces (first and second fundamental forms, curvatures), in 3 dimensional Euclidean spaces, and in 'space-time' for relativity theory.

3. Geodesics, Riemann-Christoffel tensor, Riemannian manifolds and Euclidean manifolds. Developable surfaces.

Do whatever applications you can. This is primarily intended to be an introduction to the language and skills of tensor analysis. Each department has it's own way of using tensors.

Pacing: Each of tensors and calculus of variations should receive about 5 weeks.

For Further Information See:
Ted Scheick

Spring, 1987

Mathematics 702 **3 cr.** **Integral Equations and Eigenvalue Problems**
Au

Prerequisite:

Mathematics 601 and 602.

Catalog Description:

Orthogonal functions, linear integral equations of first and second kinds, relations to ordinary differential equations, Volterra's equation, boundary value problems, approximate methods of solutions.

Purpose of Course:

To introduce the student to integral equations and their applications to the solution of ordinary and partial differential equations.

Texts:

Integral Equations, Tricomi, or Integral Equations, Hochstadt

Topics:

In addition to the topics listed in the catalog description, the Brouwer and the Leray-Schauder fixed point theorems are given and applied to non-linear integral equations (depending on the audience).

For Further Information See:
Graduate Studies Committee
Chairman

Spring, 1987

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Mathematics 703 **3 cr.** **Integral Equations and Eigenvalue Problems II**
Wi

Prerequisite:

Mathematics 702.

Catalog Description:

Distribution of eigenvalues, self-adjointness, definiteness, Green's functions, minimal properties, approximation of eigenvalues, eigenfunction expansions, Ritz method, iteration method, matrix eigenvalue problems, finite differences.

Purpose of Course:

Continuation of 702. Two courses, 702 and 703, should be considered as a unit.

Texts:

Integral Equations, Triomi, or Integral Equations, Hochstadt

For Further Information See:
Graduate Studies Committee
Chairman

Spring, 1987

Mathematics 705 **3 cr.** **Special Functions**
Wi

Prerequisite:

Mathematics 601 and 602.

Catalog Description:

Power series developments, asymptotic expansion, gamma functions, cylindrical functions, spherical harmonics, orthogonal polynomials, hypergeometric functions, theta functions, elliptic functions and integrals, numerical techniques.

Purpose of Course:

Texts:

For Further Information See:
Bogdan Baishanski

Spring, 1989

Mathematics 707 **3 cr.** **Theoretical Numerical Analysis I**
Au

Prerequisite:

Mathematics 651 and 671, or 602, or equivalent, with permission of instructor.

Catalog Description:

Introduction to Banach, Hilbert, Sobolev spaces; approximation, interpolation, variational methods, finite element method, matrix iterative methods, approximate solution of differential and integral equations, error estimation.

Purpose of Course:

This course will introduce students to the basic numerical methods underlying scientific computing. For each topic there will be a three-fold approach consisting of: an introduction, the theory underlying a method, discussion of some corresponding software, libraries and computational experimentation with practical problems.

Texts:

R. L. Burden and J. D. Faires, Numerical Analysis.

Topics:

Floating Point Arithmetic
Solution of Nonlinear Equations
Approximation Theory
Numerical Differentiation and Integration

For Further Information See:
Ted Scheick or
Ed Overman or
George Majda

Spring, 1987

Mathematics 708 **3 cr.** **Theoretical Numerical Analysis II**
Wi

Prerequisite:

Mathematics 707

Catalog Description:

Continuation of Math 707. Introduction to Banach, Hilbert, Sobolev spaces; approximation, interpolation, variational methods, finite element method, matrix iterative methods, approximate solution of differential and integral equations, error estimation.

Purpose of Course:

This course will introduce students to the basic numerical methods underlying scientific computing. For each topic there will be a three-fold approach consisting of: an introduction to the theory underlying a method, discussion of some corresponding software, libraries and computational experimentation with practical problems.

Texts:

R. L. Burden and J. D. Faires, Numerical Analysis.

Topics:

Numerical Linear Algebra
Numerical Solution of Ordinary Differential Equations

For Further Information See:
Ted Scheick or
Ed Overman or
George Majda

Spring, 1987

Mathematics 709 **3 cr.** **Theoretical Numerical Analysis III**
Sp

Prerequisite:

Mathematics 708

Catalog Description:

Continuation of 708.

Purpose of Course:

This course will introduce students to the basic numerical methods underlying scientific computing. For each topic there will be a three-fold approach consisting of: an introduction to the theory underlying a method, discussion of some corresponding software, libraries and computational experimentation with practical problems.

Texts:

G. D. Smith, Numerical Solution of Partial Differential Equations.

Topics:

Numerical Solution of partial differential equations.

For Further Information See:
Ted Scheick or
Ed Overman or
George Majda

Spring, 1987

Mathematics 722 **4 cr.** **Theory of Probability I**
Au

Prerequisite:

Mathematics 653

Catalog Description:

Introduction to basic concepts of measure-theoretic probability convergence concepts, conditioning, laws of large members, characteristic functions, central limit theorem.

Purpose of Course:

To give students a good grounding in classical probability theory and then in 724 and in the last part of 723, to introduce them to the modern theory of stochastic processes.

Texts:

To be announced.

Topics:

Probability spaces, random variables, probability distributions, Lebesgue integrals, uniform integrability, convergence of integrals, zero-one law, law of large numbers, conditional expectations.

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For Further Information See:
Neil Falkner

Spring, 1989

Mathematics 723 **4 cr.** **Theory of Probability II**
Wi

Prerequisite:

Mathematics 722

Catalog Description:

Characteristic functions, limit theorems, Markov processes, and stationary processes.

Purpose of Course:

To give students a good grounding in classical probability theory and then in 724 and in the last part 723, to introduce them to the modern theory of stochastic processes.

Texts:

To be announced.

Topics:

Characteristic functions, central limit theorems, infinitely divisible laws; introduction to stochastic processes.

For Further Information See:
Neil Falkner

Spring, 1988

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Mathematics 735 **3 cr** **Seminar in Teaching College Mathematics for International Graduate Students**

Su (2nd term)

The course is graded S/U

Prerequisite:

Permission of Graduate Advising Committee

Catalog Description:

Preparation of international graduate students for the teaching of college level mathematics courses.

Purpose of Course:

The students are foreign graduate students who have not taught in an American college before. Typically, they are students in their first quarter in this country as graduate students.

They prepare themselves to teach recitation sections of some course they would be likely to teach during their first year. In Summer, 1989, the courses used were Mathematics 151 and 152, which are calculus courses taken mainly be freshman students intending to major in Engineering. The graduate students were issued copies of the calculus textbook and "How to Teach 151 (152)" orange books, written by Frank Carroll, Director of Upper Division Undergraduate Studies.

During the five weeks of their 735 experience, the students repeatedly practice classroom teaching and get immediate feedback, including evaluation. The prospective TA develops the knowledge and skills to enable him or her to communicate mathematics clearly and effectively with undergraduate students in a recitation setting. Exemplary teacher behaviors are identified and discussed. These include good blackboard skills, clear presentation of solutions of problems, and involvement of students in the presentation of solutions.

During the first week, special emphasis is placed on areas where cultural differences might interfere with effective teaching. The graduate students learn what is to be expected in the setting of a college classroom, what American students are like, and what are the expected interactions between teachers and students. The graduate students also learn how to deal with such special situations as problem students and plagiarism.

As each meeting of the class, the graduate students take turns presenting solutions and answering questions form their colleagues, who play the role of freshman students. There is a standing invitation for actual freshmen taking 151 or 152 to attend the class, ask questions and evaluate the teaching behaviors they observe. Occasionally such freshmen do attend and participate.

When the teacher deems a graduate student sufficiently well prepared, he will send him or her to serve as a one-day replacement for a TA actually teaching a section of 151 or 152. The letter TA gives the 735 student his teaching assignment, the class is monitored by the 735 instructor, and the students evaluate the 735 student's performance.

The course is graded S/U. An S indicates that the graduate student is prepared to assume instructional duties at the level that the instructor recommends to the departmental administration. For 1988, seven students were recommended as ready for classroom teaching, five were listed as probably ready and four were recommended for grading duties.

The Math 735 course is one of the two major components in the preparation for college teaching of graduate students whose native language is different form English. The other component is training in the "English as a Second Language Program". Students in Math 735 are also enrolled either in English 104 or English 105 for the entire summer.

For More Information See:
S.K. Wong

Spring, 1989

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

Mathematics 736 **3 cr** **Seminar in Teaching College Mathematics for Domestic Graduate Students**

Su (2nd Term)

The course is graded S/U

Prerequisite:

Permission of Graduate Advising Committee.

Catalog Description:

Preparation for teaching lower-division mathematics courses.

Purpose of Course:

The students are domestic graduate students who have not taught college mathematics before. Typically, they are head start students in their first quarter as graduate students.

They prepare themselves to teach recitation sections of some course they would be likely to teach during their first year. In summer 1988, the course used was Math 131, which is a calculus course taken by freshman students intending to major in business. The graduate students were issued copies of the 131 textbook, a "How to Teach 131" orange book written by Frank Demana, Director of Freshman Studies, and a "How to Teach 151" orange book, written by Frank Carroll, Director of Upper Division Undergraduate Studies.

For the first three weeks, each student has several board sessions presenting material and answering questions from his or her colleagues, who play the role of freshman students. On a given day, half the class will be "Recitation Teachers" and half will be "Freshman Students". The students will have brought in homework, and the teachers will grade it and return it at the next class. Everyone, students and fellow teachers, fills out a written evaluation with comments on each of that day's teachers. The course instructor interrupts only rarely, and then very judiciously.

During the fourth week, the students gain experience in the design and critical evaluation of tests, and in the need for uniform grading criteria. They form teams to design an examination, but grade separately.

During the remainder of the fourth week and during the last week of the term, the students staff a Tutor Room, to which freshmen taking the courses are invited to come for help.

The course is graded S/U. A student receives an S if and only if, in the judgement of the instructor, the student is ready and able to assume the teaching duties of a graduate student.

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For More information See:
J.P. Huneke

Spring, 1989

Mathematics 741 **3 cr.** **Mathematical Foundations of the Design and Use of Automatics Systems I**
Au

Prerequisite:

Graduate standing or permission of department.

Catalog Description:

Boolean operations; reduction of systems of Boolean functions; turing machines and general recursive function; applications of problems relating to design and use of automatic systems.

Purpose of Course:

Texts:

Topics:

For Further Information See:
Harvey Friedman

Spring, 1989

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

Mathematics 742 **3 cr.** **Mathematical Foundations of the Design and Use of Automatics Systems II**
Wi

Prerequisite:

Mathematics 741 and graduate standing or permission of department.

Catalog Description:

Continuation of 741

Purpose of Course:

Texts:

Topics:

For Further Information See:
Harvey Friedman

Spring, 1989

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

Mathematics 750 - Su, Au **5 cr.** **Real Analysis I**
751 - Wi **Real Analysis II**
752 - Sp **Real Analysis III**

Prerequisite:

Mathematics 653

Catalog Description:

Relative extremes in partial orders; additive and countable additive set functions; extensions of set functions; integration, differentiation, applications.

Purpose of Course:

Texts:

Samples: W. Rudin, Real & Complex Analysis
H. L. Royden, Real Analysis
E. Hewitt & K. Stromberg, Real & Abstract Analysis

Topics:

Measure Theory
Lebesgue Integral, Differentiation of Measures, Product measures
Lp - spaces

For Further Information See:
Bill Davis

Spring, 1987

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

Mathematics 753 **5 cr.** **Introduction to Complex Analysis I**
Wi

Prerequisite:

Mathematics 653

Catalog Description:

Families of holomorphic and meromorphic functions, geometrical methods of the theory of functions, conformal transformations; including the Cauchy integral theorem, Runge's theorem, Riemann mapping theorem.

Purpose of Course:

Building on the classical foundations, to study analytic functions in the context of topological vector spaces and to apply the theory to obtain standard results coherently and efficiently.

Texts:

Instructor's choice. In 1986, the text used was: Complex Analysis, A Functional Analysis Approach, D. H. Luecking and L. A. Rubel, (Springer). Duality of H(G); application of the Hahn-Banach theorem for Runge's theorem; Cauchy theory via Runge's theorem; Riemann mapping theorem; interpolation and gaps. In 1988, the text used was An Invitation to Complex Analysis, by R. P. Boas, (Random House). Topics included Dirichlet problems, Riemann mapping theorem, Jensen's theorem, Phragmen - Lindelof results, and univalent functions.

NOTE: The sequence 753-754 is offered in the Winter and Spring of even numbered years. The lists of topics on these pages describe the material covered in recent years. In any given year, some variation is to be expected. A time-invariant description would be "Courses for serious post-proficiency students who desire more complete mastery of classical and modern results and methods in complex analysis."

For Further Information See:
Frank Carroll

Spring, 1989

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

Mathematics 754 **5 cr.** **Introduction to Complex Analysis II**
Sp

Prerequisite:

Mathematics 753

Catalog Description:

Analytic continuation, general analytic functions, algebraic, entire, elliptic, the gamma and zeta function, Dirichlet's series, Picard's theorems, Mittag-Leffler's theorem, Stirling's formula.

Purpose of Course:

Mastery of classical results and techniques required in other areas of mathematics.

Texts:

Instructor's choice. One often used is: Complex Analysis, L. V. Ahlfors, (McGraw-Hill).

Topics:

Those listed above plus applications of Schwarz's lemma, capacity, harmonic measures, Riemann surfaces. In Spring 1988, the topic was "Several Complex Variables."

NOTE: The sequence 753-754 is offered in the Winter and Spring of even numbered years. The lists of topics on these pages describe the material covered in recent years. In any given year, some variation is to be expected. A time-invariant description would be "Courses for serious post-proficiency students who desire more complete mastery of classical and modern results and methods in complex analysis."

For Further Information See:
Frank Carroll

Spring, 1989

DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
231 WEST EIGHTEENTH AVENUE
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Mathematics 760 **3 cr.** **Ordinary Differential Equations I**
Au

Prerequisite:

Mathematics 601 and 556 or equivalent.

Catalog Description:

Introduction to theory of linear and non-linear ordinary differential equations; equations with singular points; stability theory, boundary value problems.

Purpose of Course:

This course is designed to develop an expertise and awareness of the current techniques and analysis in o.d.e., including a survey of stability methods, topics in nonlinear oscillations, and dynamical systems theory.

References:

J. Hale, Ordinary Differential Equations, R. Krieger Publishing Co., Huntington, NY; F. John, Ordinary Differential Equations, Notes 1964-65, New York University.

Description:

Introduction to the theory of linear and nonlinear ordinary differential equations; equations with singular points, stability theory, boundary value problems; control systems governed by ordinary differential equations, Pontryagin's maximum principle.

For Further Information See:
Boris Mityagin

Spring, 1987

Mathematics 761 **3 cr.** **Ordinary Differential Equations II**
Wi

Prerequisite:

Mathematics 760

Catalog Description:

Continuation of 760.

Purpose of Course:

This course is designed to develop an expertise and awareness of the current techniques and analysis in o.d.e.,including a survey of stability methods, topics in nonlinear oscillations, and dynamical systems theory.

References:

J. Hale, Ordinary Differential Equations, R. Krieger Publishing Co., Huntington, NY; F. John, Ordinary Differential Equations, Notes 1964-65, New York University.

Topics:

Continuation of 760. This course is likely to emphasize special topics of interest to the instructor.

For Further Information See:
Boris Mityagin

Spring, 1987

DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
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Mathematics 763 **3 cr.** **Partial Differential Equations and Their Applications I**
Au

Prerequisite:

Mathematics 602 or 557 or equivalent, and permission of the instructor.

Catalog Description:

First order partial differential equations, theory of characteristics; second order partial differential equations; elliptic, parabolic, hyperbolic equations; standard method of solution, Green's function; integral equations.

Purpose of Course:

This sequence is aimed at the development of the fundamental theorems and methods for P.D.E's. A breif review of classification of linear second order P.D.E.'s is given.

The topics to be covered include: the general theory of partial differential equations of the first order (complete integral, Monge cones, Hamilton-Jacobi theory, etc.); potential theory and elliptic P.D.E.'s (Poisson integral, mean value theorem, maximum principles, a-priori estimates, Green's functions); hyperbolic P.D.E.'s (geometry of characterisitics, propagation and generation of discontinuties, energy estimates); parabolic P.D.E.'s.

The second course is likely to include topics of special interest to the instructor and students.

Texts:

Methods of Mathematical Physics, Vol. II, Courant and Hilbert
Shock Waves and Reaction-Diffusion Equations, J. Smoller
Linear and Nonlinear Waves, G. Whitham

For Further Information See:
Greg Forest

Spring, 1987

Mathematics 764 **3 cr.** **Partial Differential Equations and Their Applications II**
Wi

Prerequisite:

Mathematics 763

Catalog Description:

Continuation of 763.

Purpose of Course:

Continuation of 763. This course is likely to include topics of special interest to the instructor.

Texts:

Methods of Mathematical Physics, Vol. II, Courant and Hilbert

Shock Waves and Reaction-Diffusion Equations, J. Smoller

Linear and Nonlinear Waves, G. Whitham

For Further Information See:
Greg Forest

Spring, 1987

DEPARTMENT OF MATHEMATICS
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Mathematics 767
768
Au: 767
Wi: 768

4 cr. each

Introduction to the Theory of Approximation I, II

Prerequisite:

Mathematics 653 or equivalent with permission of the department.

Catalog Description:

767:
Approximation by polynomials and trigonometric polynomials, Chebeshev's theory of best approximation and its generalizations; interpolation processes and mechanical quadrature; orthogonal polynomials and elements of harmonic analysis.

768:
Continuation of 767.

Purpose of Course:

To prepare students for research work in Approximation Theory and Numerical Analysis.

Text:

An Introduction to the Approximation of Functions, T. J. Rivlin
A Practical Guide to Splines, De Boor
Approximation of Functions, Lorentz
Rational Approximation of Functions, Petrushev, Popov

Topics:

Same as the catalog description with the addition of splines, and in 768, nonlinear approximation methods.

For Further Information See:
Ranko Bojanic

Spring, 1989

DEPARTMENT OF MATHEMATICS
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Mathematics 770 **5 cr.** **Algebra I**
Au

Prerequisite:

Mathematics 672 or equivalent with permission of the instructor.

Catalog Description:

Permutation groups, solvable groups, composition series, polynomial rings, unique factorization domains, canonical forms, bilinear forms, free modules, tensor products, Galois theory, algebraic closure, transcendental extensions.

Purpose of Course:

To provide a basic foundation in group theory for students in the Ph.D program.

Text:

Lang, Algebra.

Topics:

Groups through Sylow theory; solvable and nilpotent groups; Jordan-Holder theorem; bilinear and quadratic forms; Witt's theorem; classical groups; rings and modules; UFD's; PID's; polynomial rings.

Course Coordinator:
Ron Solomon

Spring, 1987

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Mathematics 771 **5 cr.** **Algebra II**
Wi

Prerequisite:

Mathematics 770 or equivalent with permission of the department.

Catalog Description:

A continuation of 770.

Purpose of Course:

To provide a basic foundation in the theory of rings and modules for students in the Ph.D program

Texts:

Lang, Algebra.

Topics:

Finitely generated modules over PID's with applications; multilinear algebra over commutative rings; language of categories and homological algebra; Wedderburn theory.

Course Coordinator:
Ron Solomon

Spring, 1987

DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
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Mathematics 772 **4 cr.** **Algebra III**
Sp

Prerequisite:

Mathematics 771 or equivalent with permission of the department.

Catalog Description:

A continuation of 771.

Purpose of Course:

To provide a basic foundation in field theory and commutative algebra for students in the Ph.D program

Texts:

Possibilities are:

Lang, Algebra.
Jacobson, Algebra I
Van der Waerden, Algebra
Hungerford, Algebra

Topics:

Galois theory in arbitrary characteristic; transcendental extensions; finite fields; Noetherian rings; Hilbert basis theorem; rings of fractions; localization. Time permitting: topics in commutative algebra.

Course Coordinator:
Robert Gold

Spring, 1988

DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
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Mathematics	**775**	**Au**	**5 cr.**	**Combinatorics & Graph Theory I**
	776	**Wi**		**Combinatorics & Graph Theory II**
	777	**Sp**		**Combinatorics & Graph Theory III**

Prerequisite:

775: Mathematics 672 or permission of instructor
776: Mathematics 775 or permission of instructor
777: Mathematics 776 or permission of instructor

Catalog Description:

775: Transversal theory, network flows, matroids, linear programming, Ramsey Theory.

776: Combinatorial designs and geometries, difference sets, orthogonal latin squares, coding theory, enumeration theory including Mobius inversion, Polya theory, and generating functions.

777: Planar graphs and embeddings in surfaces, graph connectivity, algebraic graph theory.

Purpose of Course:

The purpose of the course is to train graduate students in the basics of Combinatorics and Graph Theory, expose them to recent developments and bring them to the frontier of research.

Texts:

There is no particular textbook. Several books are used as compliments to the class lectures.

Topics:

See catalog description above.

For Further Information See:
Dijen Ray-Chaudhuri

Spring, 1989

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

Mathematics 780 **3 cr.** **Number Theory I**
Au

Prerequisite:

Mathematics 772

Catalog Description:

Algebraic number theory.

Purpose of Course:

Introduction to algebraic number theory with emphasis on examples.

Texts:

NONE

References:
1. Hecke, Algebraic Number Theory.
2. Borevic-Safarevic, Number Theory
3. Lang, Algebraic Number Theory

Topics:

Fundamental Theorem of Ideal Theory, decompostions of primes (Kummer's theorem), Quadratic Reciproity Law, ideal class group, Minkowski's Theorem on linear forms, finiteness of class number, Dirichlet's Theorem on units, the different, relative theory, Dedekind's Theorem on ramified primes, Hilbert's ramification theory in Galois extensions, valuations, and completions.

Emphasis on examples from quadratic fields and cyclotomic fields.

For Further Information See:
Robert Gold

Spring, 1988

DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
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Mathematics 781 **3 cr.** **Number Theory II**
Diophantine Equations

Prerequisite:

Mathematics 780

Catalog Description:

Continuation of Mathematics 780

Purpose of Course:

Texts:

Topics:

I) Equations over finite fields (2 wks)
- a) Chevalley-Warning Theorem
- b) Gauss Sums
- c) Estimates for the number of solutions for $f(x) \neq 0 \pmod{p}$

II) Quaternion Algebras and Hilbert Symbol (1 wk)
- a) Local Properties
- b) Global Properties

III) Quadratics forms over Qp and over Q (3.5 wk)
- a) Local Invariants
- b) Hasse-Minkowski Theorem
- c) Existence of Forms with Prescribed Localizations
- d) Applications/Failures of Hasse Principle

IV) Selected Toopics (by instructor, some examples) (3.5 wks)
- a) Modular forms over SL2(Z), (e.g. Chap. VII of Serre)
- b) Cn Fields, Tsen-Lang Theorem, Failure of Artin Conjecture (Terjanian), Forms in many variables.
- c) Introduction to Arithmetic Theory of Quadratic Forms over Z (e.g. expanded version of Chap. V or Serre or Chap. II of Milnor-Husemoller)
- d) Introduction to Elliptic Curves of Q (e.g. chap. 1 of Koblitz)

For Further Information See:
David Goss

Spring, 1987

Mathematics 782 **3 cr.** **Number Theory III**
Sp

Prerequisite:

Mathematics 781

Catalog Description:

Analytic number theory.

Purpose of Course:

A general introduction to the subjects with emphasis on concrete examples over Q. The syllabus is to be considered as a list of possible topics to be covered - professors should use their good judgment. The material on Class-field theory is to be presented so the students obtain some idea of the reciprocity law - detailed proofs are not advised.

Text:

Lang, Janos, Goldstein, Davenport

Topics:

I) L-series and zeta functions:
- a) Dirichlet Characters
- b) Dirichlet Series, Euler Products
- c) Riemann Zeta function
- d) Dedekind Zeta function, residue at 1
- e) Dirichlet L-functions
- f) Factorization of Zeta function of an abelian extension of Q. (Dirichlet density of primes, primes in arithmetic progression)
- g) Sketch of analytic continuation of abelian L-series over Q.
- h) Abelian L-series of Galois Groups

II) Class Field Theory
- a) Generalized ideal class group
- b) Artin Map
- c) Statement of Artin Reciprocity
- d) Hilbert Class field
- e) Kronecker-Weber Theorem, Cyclotomic Fields
- f) Analyticity of Abelian L-series of Galois Groups

III) Optional Topics
- a) Idelic Formulation
- b) Local Class fields
- c) Non-abelian L-series
- d) Sketch of proof of Artin Reciprocity
- e) Power reciprocity laws

For Further Information See:
David Goss

Spring, 1987

DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
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Mathematics H783 **3-5 cr.**
Su, Au, Wi, Sp

Prerequisite:

Fourth year standing with a cumulative point hour ratio of 3.50 in math; permission of instructor under whose supervision the work is to be completed and of the ASC Honors Committee.

Catalog Description:

A program of reading and research for each student with individual conferences, reports, and honors thesis. Repeatable to a maximum of 10 credit hours. This course is graded S/U.

Purpose of Course:

Course Coordinator:
Ron Solomon

Spring, 1988

Mathematics 787.01 **3 cr** **Problems in Abstract Algebra**

Su

Prerequisite:

Permission of the Graduate Advising Committee

Topics:

Possible Syllabus:

Week 1.Problems: applications of permutation groups and the Sylow theorems. Discussion topics: the class equation and the core theorem.

Week 2.Problems: direct and semi-direct products of groups, finitely generated abelian groups. Discussion topics: examples of groups (symmetric, dihedral and classical groups..subgroups of these groups).

Week 3.Mock proficiency exam in group theory. Problems:ideal theoretic issues in commutative ring theory.

Week 4.Problems: unique factorization, principal ideal and Euclidean domains. Discussion topics: ideal structure of **Z**[X].

Week 5.Problems: linear independence and dependence, change of basis, system of equations. Discussion topics: determinants over a commutative ring.

Week 6.Problems: determinants, minimal and characteristic polynomials, Cayley Hamilton. Discussion topics: structure of finitely generated modules over principal ideal domains and applications to linear algebra.

Week 7.Problems: rational canonical form, Jordan normal form, dual spaces, Euclidean spaces. Discussion topics: quadratic forms on Euclidean spaces.

Week 8.Mock Proficiency exams on group theory, communicative ring theory, linear algebra and canonical forms.

Week 9.Problems: separable extensions, finite fields, Galois extensions. Discussion topics: the Galois group of an equation.

Week 10.Problems: splitting fields for integral polynomials, solvability of equations by radicals. Comprehensive mock proficiency exam.

1. Group Theory

Subgroups and cosets, quotient groups, normal subgroups, homomorphisms and homomorphism theorems, symmetric and alternating groups, groups acting on sets,center and commutator subgroups, p-groups, Sylow theorems, direct products and semidirect products, fundamental theorem of finitely generated abelian groups,solvable groups.

2. Ring Theory

Ideals, quotient rings, homomorphisms and homomorphism theorems, prime ideals, maximal ideals, integral domains and fields, principal ideal domains,structure of Z , K[X] , K a field, unique factorization domains such as Z[X] , division algorithm of Z , K[X] .

3. Linear Algebra

Linear independence and basis in vector spaces, linear transformations and matrices, matrix algorithms, systems of equations, determinants, eigenvalues,minimal and characteristic polynomials, Cayley-Hamilton theorem, canonical forms, dual spaces, quadratic forms on Euclidean spaces.

4. Field Theory

Finite extension of fields, Galois theory, Galois groups of an equation and solvability by radicals (all of those topics are for fields of characteristic 0); finite fields.

Recommended Courses: Algebra sequence 770, 771 and 772.

References

Herstein: Topics in Algebra
Kaplansky: Fields and Rings
Lang: Algebra

Coordination:
The Algebra Group

Summer, 1989

Mathematics 787.02 **3 cr** **Problems in Complex Analysis**

Sp

Prerequisite:

Permission of the Graduate Advising Committee

Topics:

Possible Syllabus:

The topics covered will be a subset of those on the Complex Analysis Proficiency Examination Syllabus. The choice of topics and their order of presentation will be affected by the students' backgrounds. The following would be a likely week-by-week syllabus.

Week 1. Index of a closed curve, Cauchy's theorems, strong version of Morera's theorem, open mapping theorem, argument principal, Rouche's theorem, applications. First weekend: take home test (Mock Proficiency.

Week 2. Classification of singularities, Schwartz's lemma, automorphisms of the disk.

Week 3. Conformal mappings, automorphisms of the plane, sphere, and half-plane. Theorems of Weierstrass and Hurwitz. Weekend: Mock Proficiency.

Week 4. The gamma function, basic proprieties of harmonic functions, including the maximum and mean value property.

Week 5. Poisson's formula, Dirichlet problem for the disk, a continuous function with the mean value property is harmonic.

Week 6. Two in-class semi-proficiency examinations, elementary facts about infinite products.

Week 7. Theory of power series, branches of analytic functions. Review of selected problems from previous proficiency examinations.

Week 8. Proofs of the consequences of the Cauchy Integral Formula; analysis of problems based on those consequences.

Week 9. Analytic continuation, related problems, use of the Schwartz Reflection Principle in analytic continuation. Review of selected problems from previous proficiency examinations.

Week 10. Residue Theory and applications, including proficiency problems.

Power series. The theorem on the differentiation of a convergent power series. Exponential, trigonometric, logarithmic and power functions in the complex domain. Branches of the logarithm, argument and power.

Analytic functions of a real and of a complex variable. The sum of a convergent power series is analytic. The principle of analytic continuation.

Holomorphic functions. Cauchy-Riemann equations.

Curvilinear integrals and Cauchy's theorem.

Cauchy's integral formula. Taylor's expansion. Morera's theorem. The symmetry principle Liouville's theorem. Fundamental theorem of algebra. Maximum modulus principle for functions with the mean-value property. Schwarz's lemma. Laurent's expansion. Classification of isolated singularities of an analytic function, and the behavior of the function in a deleted neighborhood of such a singularity; theorems of Riemann and Casorati-Weierstrass. Residue theorem and applications. The argument principle. Rouche's theorem. The open mapping principle.

Harmonic functions. Poisson's formula. Dirichlet's problem for a disc. Acontinuous function with the mean-value property is harmonic. First and second theorem of Weierstrass on almost uniformly convergent sequences of analytic functions. Hurwitz's theorem.Conformal mapping. Elementary mappings. Automorphisms of the plane,the Riemann sphere, the half-plane and the unit-disc.

Infinite products (elementary facts), the Gamma function.

<u>References</u>

Levinson-Redheffer: Complex Variables
Duncan: The Elements of Complex Analysis
Saks-Zygmund: Analytic Function
Cartan: Theory of Analytic Functions

Coordination:
The Analysis Group

Summer, 1989

Mathematics 787.03 **3 cr** **Problems in Real Analysis**

Su

Prerequisite:

Permission of Graduate Advising Committee

Topics:

Possible Syllabus:

The topics covered will be a subset of those given on the next page. The choice of topics and their order of presentation will be affected by the students' backgrounds. The following would be a likely week-by-week syllabus.

Week 1. Review of advanced calculus level concepts of continuity and differentiability; emphasis on inequalities.

Week 2. The Riemann integral; bounded variation; uniform convergence and its consequences, especially for interchange of limit processes.

Week 3. The Weierstrass Approximation Theorem; the Arzela-Ascoli Theorem.

Week 4. Lebesgue measure; measurable sets and functions, Borel sets. Egoroff's theorem; Lusin's theorem.

Week 5. The Lebesgue integral; convergence theorems and counterexamples.

Week 6. Absolute continuity. Radon-Nikodym theorem.

Week 7. Review.

Week 8. Produce measures and Fubini's theorem. Analysis of selected problems from previous proficiency examinations.

Week 9. Definition and properties of the classical L^p spaces; inequalities of Hoelder and Minkowski.

Week 10. Analysis of selected problems from previous proficiency examinations.

It is assumed that students are prepared in traditional advanced calculus,e.g., continuity, differentiability and integration of functions of one and several variables, sequences and series of scalars and functions, etc. The principal syllabus follows:

Asymptotic estimates and inequalities.

Riemann integrals, functions of bounded variation, absolutely continuous functions, rectifiable curves.

Sequences and series of functions. Integrals depending on parameters. Uniform convergence. Relation of uniform convergence to continuity,differentiation, integration and interchange of limits. The Weierstrass approximation theorem. Arzela-Ascoli theorem.

Power series. Elementary functions of a real variable. Basic facts about trigonometric and Fourier series.

Lebesgue measure on R . Measurable sets. Borel sets. Approximation by open and closed sets. Measurable functions on R . Approximation by simple measurable functions.Egoroff's theorem. Lusin's theorem.

The Lebesgue integral on R . Convergence theorems.

Signed measures on the line. Hahn and Jordan decomposition theorems.

Product measures. Fubini's theorem on R^n.

Holder's and Minkowski's inequalities. Completeness of Lp spaces. Dense sets in Lp.

<u>References</u>

Donald L. Cohn, Measure Theory. Birkhauser 1980.
Edwin Hewitt & Karl Stromberg, Real and Abstract Analysis. Springer-Verlag1965.
H.L. Royden, Real Analysis. Macmillan 1963.
Walter Rudin, Real and Complex Analysis. McGraw-Hill 1966.
Walter Rudin, Principles of Mathematical Analysis. McGraw-Hill 1953.
Karl R. Stromberg, An Introduction to Classical Real Analysis. Wadsworth 1981.

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THE OHIO STATE UNIVERSITY
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Coordination:
The Analysis Group

Summer, 1989

Mathematics 787.04 Su | 3 cr | Problems in Topology

Prerequisite:

Permission of the Graduate Advising Committee.

Topics:

1. General Topology

Topological spaces and continuity (neighborhoods, basis, subbasis, sequences, nets, filters, convergence)

Metric spaces and their associated topology, and other basic examples of topological spaces: the Hilbert space, 2, the space of real valued continous functions C[0,1], the Zariski topology for a ring

Connectedness, path connectedness and local connectedness

Separation properties (including Urysohn's lemma and the Tietze extension theorem)

Compactness (Heine Borel theorem, countable compactness and sequential compactness, local compactness and compactifications)

Paracompactness and partitions of unity

First and second countability, Lindeloef spaces, Metrization theorem

Special topics:

a. Baire Category theorem
b. Function spaces, pointwise and uniform convergence
c. Topological groups
d. Product and quotient spaces

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2. The Fundamental Group and Covering Spaces

Homotopy between continuous maps

The fundamental group of a space

Covering spaces and their classification

Van Kampen's theorem

Application to:

a. The fundamental theorem of algebra
b. Brouwer fixed point theorem
c. Group theory (subgroups of free groups are free)
d. Surfaces and their classifications

3. Homology (Simplicial, singular or DeRham)

Definition and properties, (Homotopy functor, Excision, Mayer-Vietoris, exact homology sequence of a pair, Euler-Poincare characteristic)

Applications:

a. Brouwer fixed-point theorem
b. Jordan separation theorem
c. Invariance of domain

CW complexes (computation of homology groups)

References

J.R. Munkres, Topology: A First Course, Prentice-Hall, 1975.

C. Kosniowski, A First Course in Algebraic Topology, Cambridge University Press, 1980.

J.R. Munkres, Elements of Algebraic Topology, Addison-Wesley, 1984.

I.M. Singer and J.A. Thorpe, Lecture Notes on Elementary Topology and Geometry, Springer-Verlag, 1976.

M.J. Greenberg and J.R. Harper, Algebraic Topology: A First Course, Benjamin-Cummings, 1981.

W.S. Massey, Algebraic Topology, An Introduction, Springer-Verlag, 1977.

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Coordinaton:
The Topology Group

Summer, 1989

Mathematics 787 **3 cr** **Graduate Problem Seminars**
Su

787.01 - Problems in Abstract Algebra
787.02 - Problems in Complex Analysis
787.03 - Problems in Real Analysis
878.04 - Problems in Topology

Prerequisite:
Permission of Graduate Advising Committee. Each decimal subdivision repeatable to a maximum of 9 credit hours.

Catalog Description:
Topics helpful in problem solving in fundamental areas of mathematics practice; with problems in a specific area of mathematics.

Purpose of Course:

The Department of Mathematics requires all Ph.D. students to demonstrate proficiency in the basic areas of Algebra, Complex Analysis, Real Analysis and Topology before they are permitted to take the General Examination. This proficiency is measured by four separate examinations, each based on published syllabi. The examinations include bothe theoretical content and problem solving techniques.

Each course taught as a decimal subdivision of Math 787 is intended to provide a common basis for the students on the tiopics and problem solving required, and, in particular, to fill gaps in the backgrounds of high ability entering graduate students. As a result, the course are partly diagnostic, partly informational, but predominatly problem solving.

In each decimal subdivision, written homework assignments, carefully graded for coherence of argument, proper English, and mathematical correctness will constitute 50% of the grade. The final examination will be worth at least 25%. The remainder will be based on board work and in-class tests.

Follow-up course:

None

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For More Information See:
Graduate Studies Committee Chair

Spring, 1989

Mathematics 804 **3 cr.** **Methods of Applied Mathematics I**
Au

Prerequisite:

Mathematics 552 or 654. 606. and 652; or written permission of Graduate Studies Committee chairperson.

Catalog Description:

An introduction to functional analysis and boundary value problems.

Purpose of Course:

Text:

Topics:

Course Coordinator:
Greg Forest

Spring, 1988

Mathematics 805 **3 cr.** **Methods of Applied Mathematics II**
Wi

Prerequisite:

Mathematics 804.

Catalog Description:

Applied complex variables and asymptotic approximations.

Purpose of Course:

Text:

Topics:

Course Coordinator:
Greg Forest

Spring, 1988

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Mathematics 806 **3 cr.** **Methods of Applied Mathematics III**
Sp

Prerequisite:

Mathematics 805.

Catalog Description:

Nonlinear oscillations, partial differential equations, and perturbation theory.

Purpose of Course:

Text:

Topics:

Course Coordinator:
Greg Forest

Spring, 1988

Mathematics 854 **3 cr.** **Lie Groups I**

Prerequisite:

Mathematics 651, 751 and 771.

Catalog Description:

Integration on manifolds, Lie groups, classical groups, homogeneous spaces.

Purpose of Course:

Texts:

Topics:

Follow-up Course:

For Further Information See:
Robert Stanton

Spring, 1987

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Mathematics 857 **3 cr.** **Introduction to Functional Analysis I**
Au

Prerequisite:

Mathematics 552 and 751.

Catalog Description:

Linear topological spaces, normed spaces, Hilbert spaces, convex sets, integration of vector-valued functions.

Purpose of Course:

(1) A one-quarter introduction to functional analysis for advanced students in branches of mathematics other than analysis.

(2) First quarter of a more complete course for students intending to specialize in functional analysis, approximation theory, operator theory, complex variables, probability, harmonic analysis, etc.

Texts:

Varies, In 85-86: A Course in Functional Analysis, J. Conway, (Springer-Verlag)

Topics:

Hilbert space, Banach spaces, locally convex spaces. Examples: Hahn-Banach Theorem, closed graph theorem, Krein-Milman Theorem.

For Further Information See:
William Davis

Spring, 1987

Mathematics 858 **3 cr.** **Introduction to Functional Analysis II**
Wi

Prerequisite:

Mathematics 857

Catalog Description:

Continuation of 857

Purpose of Course:

Second quarter of sequence for analysts.

Texts:

Varies, In 85-86: A Course in functional Analysis, J. Conway, (Springer-Verlag)

Topics:

Operators (bounded and unbounded). C* algebras.

For Further Information See:
William Davis

Spring, 1987

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Mathematics 859 **3 cr.** **Introduction to Functional Analysis III**
Sp

Prerequisite:

Mathematics 857 and 858.

Catalog Description:

Banach Algebras, spectral theory, harmonic analysis, fixed-point theorems; applications to analysis.

Purpose of Course:

Third quarter of sequence for analysts.

Texts:

Varies, In 85-86: No text.

Topics:

Varies: Possibly vector-valued integrals, measures, martingales; extreme points, or Geometry of Banach spaces.

For Further Information See:
William Davis

Spring, 1987

Mathematics 860 Au | **3 cr. each** | **Algebraic Topology I**
861 Wi | | **Algebraic Topology II**
862 Sp | | **Algebraic Topology III**

Prerequisite:

860: Mathematics 657
861: Mathematics 860
862: Mathematics 861

Catalog Description:

860: Singular homology theory.
861: Continuation of 860; cohomology theory.
862: Continuation of 860 and 861; fibrations and homotopy theory.

Purpose of Course:

860: To give a general audience the rudiments of homology theory for use in topology, algebra and analysis.

861: To give a general audience the rudiments of cohomology theory for use in topology, algebra and analysis.

862: To give a general audience the rudiments of fibrations and homotopy theory.

Texts:

860 and 861: James R. Munkres, Elements of Algebraic Topology,
862: George Whitehead, Elements of Homotopy Theory

Topics:

860: Singular homology theory with applications.
861: Singular cohomology theory with applications, Poincare duality for topological manifolds.
862: Fibrations, homotopy groups.

For Further Information See:
Henry Glover

Spring, 1987

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Mathematics 872 **4 cr.** **Group Theory I**
Au

Prerequisite:

Mathematics 672 or 772.

Catalog Description:

Properties of groups, extensions, transfer, generators and defining relations, representation theory, permutation groups.

Purpose of Course:

To acquire a deeper understanding of the structure and natural representations of finite groups and related infinite groups, e.g. algebraic and Lie groups, Fuchsian groups, etc. What (almost) every young mathematician should know about groups.

Text:

Normally, no text is used. Possible texts would include:

Group Theory I, M. Suzuki
Finite Groups, D. Gorenstein
Endliche Gruppen I, B. Huppert
Finite Group Theory, M. Aschbacher

Topics:

1. The normal structure of finite and algebraic groups; the solvable radical; the semisimple layer; the Fitting and generalized Fitting subgroups.

2. The local-global principle: local control of fusion, transfer, character theory, cohomology.

3. Famous applications (e.g. Zassenhaus groups, CN groups of odd order, Glauberman's Z*-Theorem).

For Further Information See:
Koichiro Harada or
Ronald Solomon

Spring, 1987

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Mathematics 873 **4 cr.** **Group Theory II**
Au

Prerequisite:

Mathematics 872.

Catalog Description:

Continuation of 872.

Purpose of Course:

To acquire a familiarity with the structures and associated geometries of the finite and algebraic groups of Lie type and certain other groups.

Text:

Normally, no text is used.

Topics:

1. The classical and linear groups and their geometries.
2. BN-pairs and Tits building for the classical and exceptional groups.
3. Coxeter groups, Hecke algebras and significance for representation theory.
4. Ad libitum: sporadic groups, arithmetic groups, fuchsian groups.

For Further Information See:
Koichiro Harada or
Ronald Solomon

Spring, 1987

Mathematics 874 **4 cr.** **Group Theory III**
Wi

Prerequisite:

Mathematics 873.

Catalog Description:

Continuation of 873.

Purpose of Course:

Special topics leading to specific research areas in group theory or related fields.

Text:

Normally, no text is used.

Topics:

Many possibilities, including:

1. Elliptic modular functions and the Monster group.
2. Representations theory of groups of Lie type.
3. Modular representation theory.
4. Key methods in the classification of finite simple groups.
5. Geometry of the sporadic simple groups.

For Further Information See:
Koichiro Harada or
Ronald Solomon

Spring, 1987