Department of Mathematics
The Ohio State University

1986-1987 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
134	Elements of Calculus III
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
180	Insights into Mathematics
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
256	Differential Equations with Applications
263	Accelerated Calculus and Analytic Geometry
290H	Linear Algebra & Multivariable Calculus I
291H	Linear Algebra & Multivariable Calculus II
292H	Linear Algebra & Multivariable Calculus III
345	Foundations of Higher Mathematics

Course Number	Course Title
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
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
530	Probability
531	Probability 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

Course Number	Course Title
590H	Algebraic Structures I
591H	Algebraic Structures II
592H	Algebraic Structures III
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
651	Introduction to Real Analysis I
652	Introduction to Real Analysis II
653	Introduction to Real Analysis III
654	Complex Variables
655	Elementary Topology I
656	Elementary Topology II
657	Elementary Topology III
665	Modern Mathematical Methods in Relativity Theory I
666	Modern Mathematical Methods in Relativity Theory I

Course Number	Course Title
669	Introduction to Number Theory
670	Algebra I
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
710	Projective Geometry
722	Theory of Probability I
723	Theory of Probability II
724	Theory of Probability III
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

Course Number	Course Title
782	Number Theory III
851	Differential Geometry I
852	Differential Geometry II
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

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.

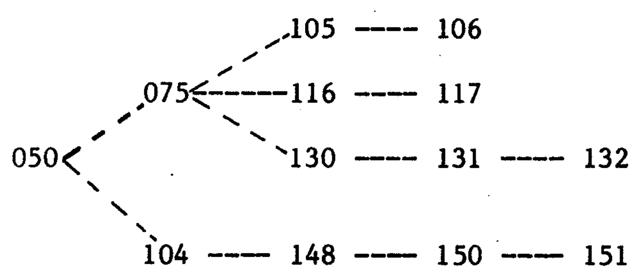
Audience:

Typically students are placed in Math 050 only if scores on the OSU Mathematics B Placement Test show serious mathematical difficulties. Often serious difficulties in general scholastic aptitude are also indicated by low ACT composite scores. The typical student has had at most two years of high school mathematics. All students who take Math 050 will need at least a next mathematics course.

Follow-up Course:

Math 075 or Math 104

Sequencing Chart:



Text:

Transition to College Mathematics, F. Demana and J. Leitzel
(Addison-Wesley, Publishers)

Chapters 1 - 6, 11.1 - 11.3

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
    - divisibility
    - order of operations
    - least common multiple
    - greatest common factor
    - distributive property
    - division algorithm
    - 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
    - compound interest
    - inflation
    - population growth
    - numerical solutions of equations
    - geometric formulas
9. Scientific notation
10. Graphs of equations
    - introduction to ordered pairs
    - graphs of polynomial equations
    - rational equations
    - exponential equations
    - problem solving graphically
11. Linear equations, slope
    - standard form
    - slope-intercept form
    - point-slope form
12. Basic geometric figures and areas
    - triangles
    - circles
    - polygons
13. Distance formula
14. Right triangles and Pythagorean Theorem
15. Extensive use of calculators

DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
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COLUMBUS, OHIO 43210

Course Coordinator:
Frank Demana

Spring, 1986

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 or R on Math Placement Test, or with credit for 050. Completion of Math 075 is required for entry into numerous degree granting colleges; however, credit for 075 will not count toward graduation in any degree granting program. It prepares students for Math 105, 116, or 130.

Audience:

We assume that all students in the course need mathematics as a tool, at least in a science course, and are likely to take additional mathematics courses. Many students will have had two or three years of high school math; others will have had less than two years. In many instances there has been a significant time interval since the student last took a math course.

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 Administrative Science (except CIS majors).

Text:

Transition to College Mathematics, F. Demana and J. Leitzel (Addison-Wesley, Publishers).

Chapters 6.5, 6.6, 7 - 10, 11.4 - 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 1986

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 Administrative Science (except CIS majors).

Text:

Algebra, A Book For Adults, Damarin and Leitzel, (Wiley, Publisher)
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. Variation and negative exponents

16. Simplifying rational expressions

17. Solution of fractional equations and applications

18. Extensive use of calculators

Course Coordinator
Glenda Woods

Spring, 1986

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

Prerequisite:

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

Audience:

We assume that all students in the course need mathematics as a tool and will continue in mathematics courses (148, 150, 151, etc.). These will include students in physical sciences, biological sciences, agricultural sciences, math, engineering or computer science curriculum. Many students will have had three or four years of high school math.

Follow-up Course:

Math 148.

Text:

Intermediate Algebra, Applications and Problem Solving, 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:
Robert Brown

Spring, 1986

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

Prerequisite:

Mathematics 075 or 104, or Course Code 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.

Audience:

Elementary education majors, mainly at the sophomore level. This course, together with 106, satisfies the mathematics requirements of the certification program for elementary teachers in the State of Ohio. Students have a very wide range of abilities, backgrounds, and interests. The College of Education requires a grade of C or better in Math 105 for admittance into the program. Students on the whole are very hard-working and conscientious.

Follow-up Course:

Math 106

Text:

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

Chapters 1-4
plus Supplements A - E, Ferrar and Leitzel (OSU Dept. of Math.)

Topics:

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

Course Coordinators:
Joe Ferrar
Jim Schultz

Spring, 1986

Mathematics 106
A, Sp

5 cr.

Mathematics for
Elementary Teachers II

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.

Audience:

Elementary education majors, mainly at the sophomore level. This course, together with 105, satisfies the mathematics requirements of the certification program for elementary teachers in the State of Ohio. Students have a very wide range of abilities, backgrounds, and interests. Students on the whole are very hard-working and conscientious.

Follow-up Course:

Math 107

Text:

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

Chapters 5-12
plus Supplement F, Ferrar and Leitzel (OSU Dept. of Math.)

Topics:

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

DEPARTMENT OF MATHEMATICS
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Course Coordinators:
Joe Ferrar
Jim Schultz

Spring, 1986

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.

Audience:

Same as 105 and 106 but much reduced in number as this is not required for certification. Only the most interested of the 105 and 106 students will enroll.

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.

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Course Coordinators:
Joe Ferrar
Jim Schultz

Spring, 1986

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. It is hoped that students may feel less intimidated by terminology and symbolism. The primary goal of the sequence is to 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.

Audience:

Generally apprehensive about mathematics. Backgrounds will vary although most have had two years of high school mathematics.

Areas listing 116 as a required course include: Agriculture (General and Industrial programs); some programs in School of Allied Medical Professions; College of the Arts (Division of Design, Visual Communication); Psychology.

Follow-up Courses:

Students may elect 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.

Text:

College Mathematics for Management, Life, and Social Sciences, 3rd Edition, R. A. Barnett and Michael R. Ziegler (Dellen Publishing, Co., San Francisco).

Chapters 1-5, 8, and 12.

TOPICS LIST

Section	Topics
1-1	Sets
1-2,1-3	Real numbers, integer exponents square roots
1-4	Linear equations and inequalities in one variable
1-5	Coordinates, lines
1-6	Relations and functions
2-1	Systems of linear equations
2-2	Augmented matrices
2-3	Gauss-Jordan elimination
2-3,2-4	Elimination, matrix operations
2-5	Matrix multiplication
2-6	Inverse matrix, matrix equations
3-1	Linear inequalities in two variables
3-2	Systems of linear inequalities
3-3	Linear programming
3-3	Linear programming
4-1,4-2	Simple and compound interest
8-1	Rational exponents and radicals
8-2	Algebraic expressions, factoring
8-3	Algebraic fractions
8-4	Non-linear inequalities
8-5	Graphing functions
12-1	Exponential functions
12-2	Logarithmic functions
12-2	Logarithmic functions
12-3	e, continuous compound interest

Course Coordinator:
Charles Saltzer

Spring, 1986

DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
231 WEST EIGHTEENTH AVENUE
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Mathematics 117
A, W, Sp, Su

5 cr.

Survey of Calculus

Prerequisite:

Mathematics 116

Catalog Description:

An introduction to differential and integral calculus.

Purpose of Course:

Emphasis is on intuitive understanding. It is hoped that students may feel less intimidated by terminology and symbolism. Primary goal of the sequence is an appreciation of calculus as one of the great inventions in history.

Audience:

A heterogeneous audience comprised of two diverse groups. One group of students is weak in mathematics having completed at most Math 116. They are generally apprehensive about math, particularly the term "calculus". The other group of students have completed Math 148 and 150 and are enrolled in 117 to satisfy the calculus requirement for Architecture majors.

Follow-up Courses:

Math 132 or Math 148 depending on student's need. Students interested in further course work in mathematics should consult the mathematics counselors in Math Building, room 110.

Text:

A. College Mathematics for Management, Life, and Social Sciences, 3rd Edition, R.A. Barnett and Michael R. Ziegler, (Dellen Publishing Co., San Francisco).

Chapters 1, 8-13

or

B. Calculus for Management , Life and Social Sciences, 3rd Edition, R.A. Barnett and Michael R. Ziegler. (Dellen Publishing Co., San Francisco).

Chapters 0-6

TOPICS LIST

Meeting number	Text A College Math Sections in Text A	Text B Calculus Sections in Text B	Topics
1	1-1 to 1-6	0-1 to 0-6	
	8-1 to 8-3	1-1, 1-3, 1-4	Review: Sets and algebra
2	8-4,8-5	1-2, 1-5	Review: Graphs and functions
3	9-1,9-2	2-1, 2-2	Limits and continuity
4	9-3	2-3	Increments, tangent lines, rates of change
5	9-4	2-4	The derivative
6	9-5	2-5	Derivatives of constants, powers, sums
7	9-6	2-6	Derivatives of products and quotients
8	9-7	2-7	Chain rule, general power rule
9	---		Review
10	---		Midterm I
11	10-1	3-1	Implicit differentiation
12	10-2	3-2	Related rates
13	10-3	3-3	Higher-order derivatives
14	11-1	4-1	Asymptotes and limits at infinity
15	11-2	4-2	First derivatives and graphs
16	11-3	4-3	Second derivatives and graphs
17	11-4	4-4	Curve sketching
18	11-5	4-5	Optimization
19	---		Review
20	---		Midterm II
21	12.1,12.2	5-1, 5-2	
	12.3	5-3	Review of exponentials, logarithms and e
22	12-4	5-4	Derivative of the logarithmic function
23	12-5	5-5	Derivative of the exponential function
24	13-1	6-1	Anti-derivatives, indefinite integral
25	13-2	6-2	Differential equations: Growth and decay
26	13-3	6-3	General power rule
27	13-4	6-4	Definite integral
28	13-5	6-5	Area
29	13-6	6-6	Definite integral as the limit of a sum
30	13-6	6-6	Review

Course Coordinator:
Charles Saltzer

Spring, 1986

Mathematics 130 4 cr. Elements of Algebra
A, W, Sp, Su

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.

Audience:

Primarily freshmen or sophomores with majors in Business (except Computer and Information Science, and Mathematical Statistics). The students in this course generally have weak algebraic skills and are often a difficult audience to motivate. The College of Business has enacted an enrollment management plan, effective Autumn, 1984. One requirement of this plan is that students complete 130, 131, 132, and all prerequisite courses with a C- or better, prior to entry into BUS. Further, a student will be allowed to repeat each course only once. A mark of W is considered by BUS as having taken the course once. Because of these requireents, students are under great pressure to succeed in this sequence.

Follow-up Course:

Math 131

Text:

Applied Mathematics for Business and Economics, Life Sciences and Social Sciences, Barnett, Burke and Ziegler, 2nd edition. (Dillon Macmillian)

§3.3, 3.4, Chapters 4, 5, 6
§7.1, 8.1, 8.2, 8.3 and supplemental material on graphing functions and logarithms.

TOPICS	SECTION
Algebra refresher, linear and quadratic equations and applications of equations	4.1, 4.3
Linear Inequalities, Applications of Equations	4.2
Applications of Inequalities, Quadratic Inequalities	4.4
Functions, Combination of Functions	5.2
Graphs of Functions	5.3
Graphing Techniques	Supplemental Material
Fractional Exponents and Radical Notion	3.3, 3.4
Exponential Functions and Graphs	Supplemental Material logarithms and exponentials
Logarithmic Functions and Graphs	Supplemental Material logarithms and exponentials
Laws of Logarithms	Material on logarithms and exponentials
Applications of Exponential and Logarithmic Functions	Supplemental Material logarithms and exponentials
Simple Interest and Discount	6.1
Compound Interest and Present Value	6.2
Annuities, Sinking Funds	6.3
Annuities; Amortization of Loans	6.4
Systems of Linear Equation, Application of	7.1
Systems of Equations	8.1, 8.2
Linear Programming in Two Dimensions	8.3

Course Coordinator:
Surinder Sehgal

Spring, 1986

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, continuity, differentiability, derivatives of the 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.

Audience:

Primarily freshmen or sophomores with majors in Business (except Computer and Information Science, and Mathematical Statistics). The students in this course generally have weak algebraic skills and are often a difficult audience to motivate. The College of Business has enacted an enrollment management plan, effective Autumn, 1984. One requirement of this plan is that students complete 130, 131, 132, and all prerequisite courses with a C- or better, prior to entry into BUS. Further, a student will be allowed to repeat each course only once. A mark of W is considered by BUS as having taken the course once. Because of these new requirements, students will be under great pressure to succeed in this sequence.

Students from 148 should be cautioned about their lack of coverage of the log and exponential functions, and should be directed to chapter 5 in their 148 or 131 textbook.

Follow-up Course:

Math 132

Text:

Introductory Mathematical Analysis, 4th Edition, Haeussler and Paul, (Reston).

Chapters 7-9

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

Course Coordinator:
Arno Cronheim

Spring, 1986

Mathematics 132 | 4 cr. | Elements of Calculus II

A, W, 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, partial derivatives, 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 and related business applications. The courses are problem oriented and little rigor is introduced.

Audience:

Primarily freshmen or sophomores with majors in The College of Business (except Computer and Information Science, and Mathematical Statistics). The students in this course generally have weak algebraic skills and are often a difficult audience to motivate. The College of Business has enacted an enrollment management plan, effective Autumn, 1984. One requirement of this plan is that students complete 130, 131, 132, and all prerequisite courses with a C- or better, prior to entry into BUS. Further, a student will be allowed to repeat each course only once. A mark of W is considered by BUS as having taken the course once. Because of these new requirements, students will be under great pressure to succeed in this sequence.

Follow-up Courses:

Stat 133 for most BUS students.

Math 134 for those students who have recently completed 131 and 132 with a grade of A or B, and are switching to the Computer and Information Science or Mathematical Statistics major. Math 134 covers material from 150, 151, and 152, so that upon completion of this course, the student may continue with 153.

Math 150 for those students who have received less than a B in 131 or 132 and are switching majors as above. Math 150 is the appropriate course for those students who are unable to handle the pace and rigor of 134.

Text:

Introductory Mathematical Analysis, 4th Edition, Haeussler and Paul, (Reston).

Chapters 10-12

TOPICS	SECTION
Indefinite Integral, Integration Formulas	10-1, 10-2
Techniques of Integration	10-3
Summation, Definite Integral, Fundamental Theorem	10-4, 10-5, 10-6
Area, Area Between Curves	10-7, 10-8
Consumers and Producers Surplus	10-9
Integration by Tables	11-3
Average Value	11-4
Improper Integrals	11-6
Differential Equations	11-7
Functions of Several Variables	12-1
Partial Derivatives	12-2
Applications of Partial Derivatives, Higher-Order Partials	12-3, 12-5
Maxima and Minima	12-7
Lagrange Multipliers	12-8

Course Coordinator:
Robert Gold

Spring, 1986

Mathematics 134* | 5 cr. | Elements of Calculus III
A

*COURSE CHANGED FROM MATH 221, effective Autumn 1983.

Prerequisite:

Math 132 or equivalent with written permission of the Department. It is recommended that students have a "B" or better in 131 and 132, and have very recently completed the 132 course. Otherwise students should take 150, 151, and 152.

Catalog Description:

Integral and differential calculus of trigonometric functions, advanced techniques of integration, area, volumes, surface area, work, moments, and polar coordinates.

Purpose of Course:

To allow strong students completing the 130 sequence to move into the 150 sequence. Upon satisfactory completion of 131, 132, and 134, the students will have a topically equivalent background to those who have taken 150, 151, 152, and are eligible to enroll in 153.

Audience:

Generally Math-Stat or CIS majors in the College of Business moving from the 130, 131, 132 sequence to the 151, 152, 153, 254 sequence. Transfer students are generally not advised to take this course and should consult a math counselor for appropriate placement.

Follow-up Course:

Math 153

Texts:

Calculus with Analytic Geometry, 2nd Edition, Edwards and Penney, and

Algebra and Trigonometry with Analytic Geometry, 6th Edition, Swokowski.

Course Coordinator:
Robert Gold

Spring, 1986

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.

Audience:

Students with majors in the College of Engineering and the College of Mathematical and Physical Sciences generally take this course. Some majors in the College of Agriculture, Education and the College of Biological Sciences also require this course. The students in this course have a very wide range of abilities and interests and typically have completed 4 years of high school mathematics. The overall attitude of the student audience is good. They are usually well-motivated.

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

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.
Variation

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
Partial fractions, Polynomial Division

V. Introduction to Complex Numbers and Complex Roots of Equations

Course Coordinator:
Bob Gold

Spring, 1986

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.

Audience:

Students with majors in the College of Engineering and the College of Mathematics and Physical Sciences generally take this course. Some majors in the College of Agriculture, Education and the College of Biological Sciences also require this course. The students in this course have a wide range of interests and most need to take calculus. Most students have a strong algebra background and are well-motivated.

Follow-up Course:

Math 151

Text:

Fundamentals of Algebra and Trigonometry with Analytic Geometry, 6th Edition, Swokowski.

Chapters 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

Unit Circle
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

Course Coordinator:
Ted Scheick

Spring, 1986

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.

Audience:

Mathematics, engineering, computer science, and physical and biological sciences majors. Some majors in agriculture and other areas. These students are well-motivated, and their overall attitude is good. Their algebra skills are often not as good as might be hoped.

Follow-up Course:

Math 152

Text:

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

Portions of Chapters 1 and 10; 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 sins and cosines
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
10.1	Conic sections
10.4-10.5	Parabola, ellipse
10.6	Hyperbola

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For further information see:
Frank Carroll

Spring, 1986

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

Prerequisite:

Mathematics 151

Catalog Description:

Integral, area, fundamental theorems of calculus, logarithm 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.

Audience:

Mathematics, engineering, computer science, and physical and biological sciences majors. Some majors in other areas. These students are well-motivated, and their overall attitude is good. Their algebra skills are often not as good as might be hoped.

Follow-up Course:

Math 153

Text:

Autumn 1986

Calculus with Analytic Geometry, 2nd edition, Ellis and Gulick.
Chapters 5 - 8

Winter 1987 and thereafter

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

Chapters	Topics List	Approximate Number of Weeks
5. The Integral		2
	Partitions, approximating the area under a curve	
	Definite integral in terms of upper and lower sums	
	Properties of the definite integral, Mean Value Theorem for integrals	
	Fundamental Theorem of Calculus	
	Indefinite integral	
	Integration by substitution	
	Natural logarithmic function as an integral	
6. Inverse Functions		2 1/2
	Properties and graphs of inverse functions, properties of functions which have inverses	
	Continuity and differentiability of inverse functions	
	Natural exponential function	
	General exponential and logarithmic functions	
	Exponential growth and decay	
	Inverse trigonometric functions, integral formulas corresponding to the derivatives of inverse trig functions	
	Hyperbolic functions and identities, inverse hyperbolic sine	
	Generalized Mean Value Theorem	
	Indeterminate forms, L'Hopital's Rule	
7. Techniques of Integration		3
	Integration by parts	
	Integration of multiples and products of trig functions	
	Trigonometric substitution	
	Partial fractions, integration by partial fractions	
	Riemann sum, use of the Riemann sum to approximate the definite integral, error estimation, Riemann integral	
	Trapezoidal Rule, use of the Trapezoidal Rule to approximate the definite integral, error estimation	
	Simpson's Rule, use of Simpson's Rule to approximate the definite integral, error estimation	
	Improper integrals: integrals with unbounded integrands, integrals over unbounded intervals, convergent and divergent improper integrals	
8. Applications of the Integral		2 1/2
	Calculating the volume of a solid by the cross-sectional method, including the disc method and washer method	
	Calculating the volume of a solid by the shell method	
	Length of the graph of a function	
	Calculating the surface area of a solid obtained by revolving the graph of a function about an axis	
	Moment of a plane region about an axis, center of gravity	
	Polar coordinate system, conversion between Cartesian and polar coordinates, polar equations and graphs	
	Calculating the area of a region using polar coordinates	

Edwards and Penney

Chapter	Title	Aproximate # of weeks
5	The Integral	2.5
6	Applications of the Integral	2
7	Exponentials and Logarithms	1.5
8	Trigonometric and Hyperbolic Functions	1.5
9	Techniques of Integration	2
10	(Area in polar coordinates)	.5

Course Coordinator:
Frank Carroll

Spring, 1986

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Mathematics 153
A, W, Sp, Su

5 cr.

Calculus and
Analytic Geometry

Prerequisite:

Mathematics 152 or 134

Catalog Description:

Vector and analytic geometry in two and three dimensions. Functions of several variables, partial derivatives, directional derivatives, gradients, extrema. Multiple integrals and applications. Cylindrical and spherical coordinates.

Purpose of Course:

To provide students with a solid foundation in several-variable differential and integral calculus.

Audience:

Students majoring in mathematics, engineering, computer science, or the physical sciences; also strong students in the social sciences or other areas that make significant use of mathematics.

Follow-up Course:

Math 254

Text:

Calculus with Analytic Geometry, 2nd edition, Ellis and Gulick.

Chapters 11, 13, 14.

TOPICS LIST

Vectors in space
Dot Product
Cross and triple products
Lines in Space
Planes in Space
Functions of several variables
Limits & Continuity
Partial Derivatives
Chain Rule
Directional Derivatives
Gradient
Gradient
Tangent Plane and differentials
Extreme values
Lagrange Multipliers
Double Integrals and evaluation
Polar Coordinates
Surface area
Triple Integrals
Triple Integrals in Cylindrical coordinates
Triple Integrals in Spherical coordinates
Moments and center of Gravity
Change of variables in multiple integrals

Course Coordinator:
Ted Scheick

Spring, 1986

Mathematics 161* A

5 cr.

Accelerated Calculus and Analytic Geometry

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

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 outside of class.

Follow-up Course:

Math 162

Text:

Calculus, by H. Flanders, (Chapters 1-7).
(Part I: Chapters 1-7)

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.

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Course Coordinator:
Daniel Shapiro
R. Solomon (Honors)

Spring, 1986

Mathematics 162*
W

5 cr.

Accelerated Calculus and Analytic Geometry

* 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 3-course sequence, 161-162-263, is equivalent in content to the 4-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:

Calculus, H. Flanders, (Chapters 9-13)

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, 1986

* This course has been put in limbo effective Summer, 1985 and will not be offered during 1986-87.

Prerequisite:

Mathematics 102, or Course Code R on Math Placement Test.

Catalog Description:

A liberal arts course intended to involve students with mathematics; topics chosen by the instructor.

Purpose of Course:

Many students at The Ohio State University take mathematics courses for the purpose of satisfying a graduation requirement but with no need for specific problem-solving skills. This course is a liberal arts course that emphasizes involvement with diverse problems in mathematics. There is no fixed course content. Rather, a faculty member offers a course treating topics in which he or she is interested in a manner that is accessible to students satisfying the course prerequisites.

We feel that this approach is the proper one for a liberal arts course. It enables us to take advantage of the interests of faculty members and to avoid problems inherent in offering a fixed subject matter course to a large audience. To date we have involved several faculty members offering a variety of topics. Four of the many topics used have been Probability and Games of Chance, Symmetry (in art and music), Topology, and Number Theory.

This course also satisfies the mathematics requirement for certification at the secondary level for many areas.

Audience:

Predominantly students in the College of Arts and Sciences and some students from the College of Education.

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Course Coordinator:
Frank Demana

Spring, 1986

Mathematics 187 A

2-5 cr.

Topics in Mathematics

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.

Audience:

Students primarily at the calculus level.

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Course Coordinator:
Alayne Parson

Spring, 1986

Mathematics H190 | 5 cr. each | 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.

Audience:

Most students in H190 either have received College Board Advanced Placement credit in calculus, or have studied calculus in high school and have a math ACT score $\geq$ 32 or Math SAT score $\geq$ 700.

Follow-up Sequence:

Math H290, H291, H292

Text:

Calculus, Volume I, Apostol.

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.

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Course Coordinator:
Alayne Parson

Spring, 1986

Mathematics 254 | 5 cr. | Calculus and Analytic Geometry
A, W, Sp, Su

Prerequisite:

Mathematics 153

Catalog Description:

Curves, line integrals; Green's theorem; indeterminant forms, improper integrals, sequences and series.

Purpose of Course:

To provide students with a solid foundation in vector calculus and infinite series.

Audience:

Students majoring in mathematics, engineering, computer science, or the physical or biological sciences; also strong students in the social sciences or other areas that make significant use of mathematics.

Text:

Calculus with Analytic Geometry, 2nd edition, Ellis and Gulick.

Chapters 9, 12, 15

TOPICS LIST

Vector valued functions
Limits & continuity
Derivatives and Integrals
Space curves, length
Tangents and normals
Vector Fields
Line Integrals
Fundamental Theorem of Line Integrals
Green's Theorem
Surface Integrals
Integrals over Oriented Surfaces
Stoke's Theorem
Divergence Theorem
Taylor's Theorem
Sequences
Convergence properties of sequences
Infinite Series
Integral and comparison test
Root, Ratio tests
Alternating series, absolute convergence
Power Series
Taylor Series
Binomial Series

Course Coordinator:
Ted Scheick

Spring, 1986

Mathematics 255
A, W, Sp, Su

5 cr.

Differential Equations
and Their Applications

Prerequisite:

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

Catalog Description:

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

Purpose of Course:

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

Audience:

Primarily engineering, mathematics, and physical science majors.

Text:

Fundamentals of Differential Equations, by Kent Nagle and Edward Saff.

Chapters 1, 2, 3, 4, 6, 7, 8

Suggested Syllabus

Chapters	Approximate Number of Days
1. Introduction: Sec. 1.1, 1.2 (1.3 Optional)	1
2. First-Order Differential Equations 2.1, 2.2, 2.3, 2.4 and 2.6	4
3. Mathematical Models 3.2, 3.3, 3.5	3
REVIEW	1
-- Suggested Test 1	
4. Linear Second Order Equations 4.2 - 4.10	10
6. Higher Order Linear Differential Equations 6.2 - 6.5	4

Remark. If the teacher prefers to combine Chapters 4 and 6 he or she may do so.

REVIEW	1
-- Suggested Test 2	1
7. The Laplace Transform 7.1 - 7.7	8
8. Series Solution of Linear Differential 8.2 - 8.7 and part of 8.9 (Bessel's equation)	12

Optional Material (if time permits):
Sections 2.5; 5.1-5.3 (brief overview of problems),
8.8; 9.2-9.3

Remark: 1. Chapter 8 must not be started later that 2 1/2 - 3 weeks before the end of the quarter.

2. Third test should be added sometime during the latter part of the quarter.

Course Coordinator:
Zita Divis

Spring, 1986

Mathematics 256
A, W, Sp, Su

4 cr.

Differential Equations
with Applications

Prerequisite:

Mathematics 254. Not open to students with credit for 255, 415, or 556.

Catalog Description:

First order differential equations, linear equations with constant coefficients, systems of linear equations, applications to vibrations problems and electrical networks.

NOTE:

This course was offered for the mechanical engineering students through Autumn 1985. However, their differential equations requirement has changed to Math 415. Consequently this course will not be offered for the 86-87 academic year.

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Course Coordinator:
Joe Rosenblatt

Spring, 1986

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 H290 or other course in differential equations and linear algebra.

Text:

Calculus, H. Flanders, (Chapters 14-18)

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.

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Course Coordinator:
Daniel Shapiro
Ron Solomon (Honors)

Spring, 1986

Mathematics H290 5 cr. each Linear Algebra and Multivariable Calculus I
H291 Linear Algebra and Multivariable Calculus II
H292 Linear Algebra and Multivariable Calculus III

A - H290
W - H291
Sp - H292

Prerequisite:

Mathematics H263, H264 with a grade of C or better for H290, or permission of Honors Committee.

Catalog Description:

H290, H291, H292 is an integrated sequence in linear algebra, matrix-theory, multivariable calculus, ordinary and partial differential equations, and complex analysis.

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 considerale teacher-student interaction.

Audience:

Most students in this sequence have completed the H161-H162-H263 sequence or the H190-H191-H264 sequence.

Texts:

Strang, Linear Algebra and It's Applications
Lipschutz, Schaum's Outline/Theory and Problems of Linear Algebra,
Boyce and DePrima, Elementary Differential Equations and Boundary Value Problems, 3rd edition
Churchill, Complex Variables and Applications, 4th edition

Topics:

H290:
Vector spaces, linear maps, matrices, systems of equations, eigenvalues, eigenvectors, and determinants. Change of basis and triangular form. Positive definite matrices and spectral theory. Linear methods applied to multivariable calculus such as implicit function theorems.

H291:
Linear differential equations, systems of linear differential equations, partial differential equations. Picard's existence and uniqueness theorem. Laplace transforms. Fourier series. Heat and wave equations. Sturm-Liouville boundary value problems.

H292:
Complex Analysis as done in, for instance, Chapters 1-9 and 12 of Churchill.

Course Coordinator:
Alayne Parson

Spring, 1986

Mathematics 345*
A, Sp

4 cr.

Foundations of Higher Mathematics

* This course has been put in limbo effective Autumn, 1983 and will not be offered during 1986-87.

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.

Audience:

Students will generally be sophomores who have completed a calculus sequence and anticipate some 500-level courses.

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 principal.
6. Transfinite numbers (never seem to get to this).

Course Coordinator:
Robert Gold

Spring, 1986

Mathematics 366
A, W, Sp, Su (1st Term)

3 cr.

Discrete Mathematical Structures I

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; monoids, groups; 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.

Audience:

Required for students majoring in C.I.S. Some students are math majors. Students will usually be Sophomores or Juniors.

Follow-up Course:

Math 566.

Text:

Ross - Wright, Discrete Mathematics, Prentice-Hall

Topics:

I. Set Theory and Algorithms
   A. Sets, products
   B. Relations, functions, operations
   C. Algorithms
   D. Complexity
   E. Mathematical induction

II. Combinatorics
   A. Permutations, combinations
   B. Binomial coefficients
   C. Recurrence relations

III. Boolean Algebras
   A. Combinatorial circuits
   B. Boolean algebras
   C. Propositional calculus

IV. Graphs
   A. Paths, circuits
   B. Isomorphisms
   C. Planar graphs

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

Course Coordinator:
Tom Dowling

Spring, 1986

Mathematics 415 | 5 cr. | Ordinary and Partial Differential Equations
A, W, Sp, Su

Prerequisite:

Mathematics 254

Catalog Description:

Ordinary, partial, linear and non-linear 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).

Audience:

This course was designed by a committee (primarily of engineers). It is intended to expose electrical engineering, astronautical engineering, mechanical engineering, and CIS students to problem solving in differential equations. The students usually come to the course from the calculus sequence.

Text:

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

Topics:

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:
R. Stanton

Spring, 1986

Mathematics 416 | 5 cr. | Vector Analysis and Complex Variables
A, Sp

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

Audience:

At present, almost all students are juniors in Engineering.

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:
Joe Rosenblatt

Spring, 1986

Mathematics 471 | 5 cr. | Matrices and Linear Algebra
A, W

Prerequisite:

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

Catalog Description:

Matrices, systems of equations, 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 H290, 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.

Audience:

The course is required for Information System majors in the College of Administrative Sciences. Students have a strong desire to see application of this material, i.e., a "how-to-solve-it" approach.

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

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

Topics:

Matrices -- arithmetic, inverse, transpose, rank;

Systems of equations -- homogeneous and nonhomogeneous;

Vector spaces -- R^n, independence, spanning sets, basis;

Convex sets, basic feasible solutions, extreme points

Linear Programming

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Course Coordinator:
Bostwick Wyman

Spring, 1986

Mathematics H487 2 cr. Advanced Problem Solving
A

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.

Audience:

Primarily upperclassmen.

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Course Coordinator:
Alayne Parson

Spring, 1986

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

Prerequisite:

Permission of department.

Catalog Description:

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

Purpose of Course:

This course serves those graduate students in departments outside the College who need mathematics in their majors but whose undergraduate training in mathematics is insufficient.

Audience:

This course is intended for advanced students in areas other than the mathematical and physical sciences.

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.

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Course Coordinator:
Archie Addison

Spring, 1986

Mathematics 501S
W — Saturdays

4 cr.

General Mathematics Review for Students of Actuarial Science

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.

Audience:

This course reviews calculus and elementary linear algebra with intensive drill in problem solving. This course is for the student who needs to renew mathematical skills acquired in the past and is undertaking a professional course of study which includes mathematics examinations.

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 expansions;
the mean value theorem;
linear equation, vector spaces, generating sets;
bases and dimension;
subspaces;
scalar products;
linear transformations;
kernel and image space;
matrices;
determinants;
eigenvectors and eigenvalues.

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Course Coordinator:
Robert Brown

Spring, 1986

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 yester-year. Also, an attempt is made to place the evolution of mathematics in a historical setting.

Audience:

This course is principally a service course for the Math Education department. It is not required in the 40-hour requirement necessary for a math major. However, if taken as an elective, it could benefit the math major greatly. (95% of the audience are Math-Ed students.) The background and motivation of the average student in this course is weak. The students often have difficulty organizing their thoughts on paper.

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 List

(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

Course Coordinator:
Charles Saltzer

Spring, 1986

Mathematics 507 5 cr. Advanced Geometry
A, W

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.

Audience:

The course is required for College of Education students specializing in the teaching of secondary school mathematics. A few of the students are enrolled in Arts and Sciences or Engineering.

Most students have weak backgrounds in high school geometry and analytic geometry.

Topics:

1. Review of high school geometry.

2. Euclidean motions, similarities and affine transformations.

3. Circular inversion or finite geometries (optional).

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Course Coordinator:
Arno Cronheim

Spring, 1986

Mathematics 510.01
510.02
510.03

2-5 cr.

Topics in Mathematics for Elementary School Teachers

A, W, Sp, Su

Prerequisite:

1 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 cr. hrs. for each decimal subdivision with written permission of department.

Audience:

Designed for In-Service teachers.

Topics:

510.01	Geometry
510.02	Properties of Numbers
510.03	Numerical Methods

Course Coordinator:
Jim Leitzel

Spring, 1986

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

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

Prerequisite:

Mathematics 255 or 256 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 course is a three hour course with 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.

Audience:

Graduate and advanced undergraduate engineers.

Texts:

Advanced Engineering Mathematics, O'Neil, (Wadsworth).

Advanced Engineering Mathematics, 5th 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.

   O'Neil: Chap. 12, Sections 12.0 - 12.4 and 12.8.

   Kreyszig: Chap. 10, Sections 10.1 - 10.5; 10.7 and 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.

   O'Neil: Chap. 13, Sections 13.0, 13.2, 13.3 (13.6 optional).

   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.

   O'Neil: Chap. 4, Sections 4.0 - 4.9.

   Kreyszig: Chap. 5, Sections 5.1 - 5.7.

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, 1986

Mathematics 513 | 3 cr. | Vector Analysis for Engineers
W

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.

Audience:

Students are mainly graduate engineers whose last course was several years ago.

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, 1986

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.

Audience:

Undergraduates and graduate engineers. Do not overestimate the students' computational skills because they are engineers; in fact, class discussion of assigned problems is helpful. Discuss the theory, but spend most of the time sharpening computational skills and showing them how to use the theory.

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 the theorems on power series.)	1/2
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.	

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Course Coordinator:
Ted Scheick

Spring, 1986

Mathematics 530 W | 3 cr. | Probability I

Prerequisite:

Mathematics 254
Not open to students with credit for Statistics 520

Catalog Description:

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

Purpose of Course:

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

Audience:

Majors in mathematics, actuarial science, physics, engineering (especially electrical engineering), biological sciences. There are many students in the course who are not mathematics majors. For the most part, the students are interested and hard-working.

Follow-up Course:

Math 531

Text:

Elementary Probability Theory with Stochastic Processes, K. L. Chung.

Chapters 1-6

Topics:

Sets
Counting
Independence and conditioning
Limits and theorems
Probability
Random variables
Mean, variance

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Course Coordinator:
Louis Sucheston

Spring, 1986

Mathematics 531 3 cr. Probability II
Sp

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.

Audience:

Majors in mathematics, physics, engineering (especially electrical engineering), biological sciences. There are many students in the course who are not mathematics majors. For the most part the students are interested and hard-working.

Follow-up Course:

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

Text:

An Introduction to Probability Theory and Its Applications, 3rd edition, W. Feller.

Chapters 15, 17

Topics:

Markov Chains

Definitions and examples, classification of states and chains, first passage time, stationary distributions, random walks, applications (genetics, Ehrenfest model for diffusion)

Simplest Time - Dependent Stochastic Processes

Poisson process, pure birth process, birth and death process, applications to queuing theory

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Course Coordinator:
Louis Sucheston

Spring, 1986

Mathematics 547 | 3 cr. | Introductory Analysis I

A, W, Su (1st Term)

Prerequisite:

Mathematics 254.

Catalog Description:

547 - 548 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.

Audience:

The students will be principally mathematical and physical science majors and engineers. Math 547 and 548 currently satisfy the analysis requirement for a math major.

Follow-up Course:

Math 548.

Text:

Avner Friedman, or
Watson Fulks, or
Anthony Labarre, or
Kenneth A. Ross, or
Angus Taylor and Robert Mann

Topics:

1. A careful study of limits of sequence and functions and properties of the limit process; here it is proved that a bounded sequence of real numbers has a convergent subsequence.

2. A study of continuous functions including the proofs of the intermediate value theorem and the theorem that a continuous function on a closed, bounded interval is uniformly continuous.

3. Depending on the chosen text, either (i) "Infinite Series" with the proofs of standard tests or, (ii) Differentiation (including Mean Value and Taylor's Theorems), and (iii) The Riemann Integral (Properties; Fundamental Theorem of Calculus).

Sample Syllabus

Using Kenneth Ross: Elementary Analysis: The Theory of Calculus
(Published by Springer Verlag

Chapter 1: §1 Mathematical Induction (pp. 2-4) with exercises on p. 4, 5.

§2 Exercises on p. 9 (text may be assigned for reading).

§3 Triangle Inequality (p. 1) with exercises 3.5-3.7. Add more exercises using inequalities, absolute values (e.g. from Fulks).

§4 Do all with selected exercises.

§5 Selected exercises (text for reading).

Chapter 2: Most of the material should be covered. Use your own judgment as to which proofs should be done in class; obviously not everything can be proved.

REMARKS:

On page 53 "subsequential limit" is defined; it is more common to call it "cluster point".

§ 13 Metric spaces normally are NOT introduced in 547 and should NOT be covered. Do theorems 13.5 and 13.12 in R only. For references, one can use e.g. Fulks.

§14 and §15 More problems should be added.

Chapter 3: Skip §21, §22 except for Corollary 21.5 in R. If time permits, do §37 (p. 226)

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Course Coordinator:
Zita Divis

Spring, 1986

Mathematics 548 3 cr. Introductory Analysis II
W, Sp, Su (2nd Term)

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.

Audience:

The students will be principally mathematical and physical science majors and engineers. Math 547 and 548 currently satisfy the analysis requirement for a math major.

Follow-up Course:

Math 549 or 551 or 552.

Text:

Avner Friedman, or
Watson Fulks, or
Anthony Labarre, or
Kenneth A. Ross, or
Angus Taylor and Robert Mann

Topics:

548 is a continuation of 547 including the following topics:

1. Depending on the chosen text, either start with Series (if not covered in 547) or with Abel's partial summation (if basic facts about Series were covered).

2. Abel's partial summation. Sequences and series of functions with a careful study of the consequences of uniform convergence.

3. Do "Differentiation" and "The Riemann Integral" if these were not done in 547. Otherwise "Improper Integrals" should be covered with lots of exercises.

Sample Syllabus (using Kenneth Ross)

Review Series from Chapter 2. Add: Abel's partial summation.

Chapter 4: Do all and when doing §24 add Abel's and Dirichlet's tests with exercises (e.g. use Fulks). Not every theorem needs to be proved - use your judgment.

Chapter 5: Do all and add to §31 applications of Taylor's theorem with exercises.

Chapter 6: Do §32-§36 with more difficult exercises added to §36.

Course Coordinator:
Zita Divis

Spring, 1986

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.

Audience:

The students will be principally mathematical and physical science majors and engineers.

Follow-up Course:

Math 551 or 552.

Text:

Avner Friedman, or
Watson Fulks, or
Anthony Labarre, or
Angus Taylor and Robert Mann

Topics:

1. An introduction to functions of bounded variations through the study of the Riemann-Stieltjes integral.

2. The calculus of several variables with the emphasis on differentiable functions; Green's theorem and then multiple integration, including proofs that iterated integrals do compute volumes under sufficiently strong hypotheses.

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Course Coordinator:
Zita Divis

Spring, 1986

Mathematics 551 — 5 cr. — Vector Analysis
A, Sp

Prerequisite:

Mathematics 254

Catalog Description:

Vector operations in three dimensions, vector operators, surface area, the theorem 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

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, 1986

Mathematics 552
W, Su

5 cr.

Introduction to the Theory of Functions of a Complex Variable

Prerequisite:

Mathematics 254

Catalog Description:

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

Purpose of Course:

The students are to learn the basic facts and techniques of complex variables, as done in, for instance, the first eight or more chapters of Churchill. 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.

Audience:

Recommended in a math major program. Required in the Physics program (they take 551 and 552, but not advanced calculus). Occasional engineering graduate students. The background and attitude of the audience is good.

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, 1986

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.

Audience:

Math majors, students interested in the Applied Math program and other students interested in the theory of differential equations.

Text:

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

or 2) David Powers: Elementary Differential Equations with Boundary Value Problems.

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 and chapter 9 of Part III in the book)

4. Numerical methods (about 1 week)

For topics #2 and #4, supplementary material may be needed. Material is contained also in Chapters 6, 7, 8 of Powers.

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Course Coordinator:
Zita Divis

Spring, 1986

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:

To provide the student with the modern mathematical foundations of differential equations and to develop qualitative and computational concepts and tools.

Audience:

Math majors, students interested in the Applied Math program and other students interested in the theory of differential equations.

Possible Text:

Haberman: Elementary Applied Differential Equations, or D. Powers: Elementary Differential Equations with Boundary Value Problems, and supplementary material from Hildebrand: Advanced Calculus for Applications.

Topics: (Suggested material)

Sturm - Liouville eigenvalue problems.

Partial Differential Equations (elements)

Nonhomogeneous problems

Green's functions

(For example, in Haberman, this material is contained in Chapters 5-10; in Powers in Chapters 9 and 10).

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

Course Coordinator:
Zita Divis

Spring, 1986

Mathematics 558 | 3 cr. | Differential Geometry of Curves and Surfaces
W

Prerequisite:

Mathematics H292, 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
   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 (2 weeks)
   A. Definition and basic properties
   B. The Gauss map in local coordinates
   C. Ruled surfaces

IV. Intrinsic geometric properties (3 weeks)
   A. Isometrics; conformal maps
   B. Theorema Egregium
   C. Parallel transport; geodesics
   D. The Gauss-Bonnet theorem and applications

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Course Coordinator:
H. Glover

Spring, 1986

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.

Audience:

Undergraduate students majoring in Mathematics, Secondary Education, or other areas, as well as graduate students from areas other than Mathematics, which use topological notions.

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.

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Course Coordinator:
H. Glover

Spring, 1986

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:

Elementary number theory, coding theory, continuation of groups, graphs, and enumeration from 366 with applications to topics in computer science.

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.

Audience:

Required for some undergraduate students majoring in CIS. Students will usually be Sophomores or Juniors.

Text:

Ross - Wright, Discrete Mathematics, Prentice-Hall

Topics:

I. Trees
   A. Properties of trees
   B. Spanning trees
   C. Sorting
   D. Game Trees

II. Network flows and other graph related algorithms
   A. Maximal flow algorithm
   B. Max Flow - Min Cut Theorem
   C. Matching

III. Elementary Number Theory
   A. Divisibility
   B. Primes
   C. Congruences
   D. Chinese Remainder Theorem
   E. Finite fields

IV. Coding Theory
   A. Error correcting & detecting codes
   B. Group codes

Course Coordinator:
Tom Dowling

Spring, 1986

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 R^n and its subspaces; matrices as mappings; matrix algebra; systems of equations; determinants; dot product in 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 R^n. Emphasis is on techniques, computational skills, and development as algebraic structure.

Audience:

The students are predominantly sophomores having no prior experience with linear algebra or "proof". Along with servicing mathematics majors, the course will probably also enroll students in the physical sciences, secondary math education, CIS, engineering, and mathematical sciences.

Follow-up Course:

Math 569.

Text:

An Introduction to Linear Algebra, Johnson and Reiss

Chapter 1: sections 1.1 - 1.8

Chapter 2: sections 2.1 - 2.6

Supplemental notes to replace 3.1 - 3.3 and 3.6 - 3.9

Chapter 3: section 3.4

Chapter 5: portions of, if time permits

Topics List

1. The space R^n (addition and scalar multiplication).

2. Subspaces of 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 R^n; orthogonality and orthonormal bases.

Suggested additional topics as time permits: further experience with characteristic roots and vectors; other vector spaces over R^n, e.g., the space of matrices, function spaces.

Course Coordinator:
William McWorter

Spring, 1986

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 R and C; linear transformations; the polynomial ring 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.

Audience:

Predominantly a service course for physical sciences, CIS, engineering and mathematical sciences majors.

Text:

An Introduction to Linear Algebra, Johnson and Reiss.

Chapter 3 or supplemental materials: Review

Chapter 3: 3.9, 3.10 (optional)

Cayley-Hamilton Theorem

Chapter 4: 4.1 - 4.10

Chapter 2: 2.5; 2.6 optional review prior to 4.6

May require additional supplementary material.

Topics List

1. Definitions and examples of vector spaces over R and C (include $M_{m,n}(R)$ and function spaces).

2. Definition of linear transformations; kernel, image, isomorphisms; dimension relations.

3. Vector space structure of $Hom_R(V,W)$ and relation to $M_{m,n}(R)$ with choice of bases.

4. Elementary properties of the polynomial rings R[x], 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.

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Course Coordinator:
William McWorter

Spring, 1986

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.

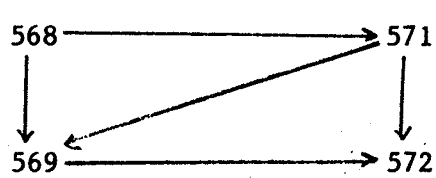
Text:

Linear Algebra with Applications, S. Leon

Topics List:

Chapter 1:	Systems of Linear equations, Row Echelon form, Matrix Algebra, Special types of matrices, partitional matrices.	8 classes
Chapter 2:	The Determinant of a matrix, Properties of Determinants. Cramer's rule.	2 classes
Chapter 3:	Vector spaces. Subspaces. Linear independence. Basis and dimension. The row space and column space.	6 classes
Chapter 4:	Linear transformations. Matrix representation. Similarity.	3 classes
Chapter 5:	Scalar product in R^n , orthogonal subspaces, inner product spaces. Matrix Norms. Least Squares problems. Orthogonal sets, Gram-Schmidt process. Orthogonal polynomials.	8 classes

Routing Scheme



Course Coordinator:
T. Scheick

Spring, 1986

Mathematics 572 | 3 cr. | Linear Algebra for Applications II
W, Su (2nd Term)

Prerequisite:

Math 571 or written permission of the department.

Catalog Description:

The eigenvalue problem or inner product spaces, projections and least squares approximation. Classification of operators and quadratic forms. Applications.

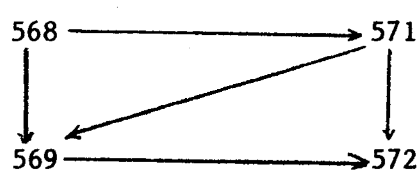
Text:

Linear Algebra with Applications, S. Leon

Topics List:

Chapter 6:	Eigenvalues and Eigenvectors. Systems of linear differential equations, Diagonalization, complex matrices. Quadratic Forms. Positive Definite matrices. Non negative matrices.	11 classes
Chapter 7:	Floating Point Numbers. Gaussian Elimination. Pivoting Strategies. Condition number of a matrix. Orthogonal transformations. Iterative methods for solving linear systems. Singular value decomposition. Eigenvalue problem. Least squares problems.	16 classes

Routing Scheme



Course Coordinator:
T. Scheick

Spring, 1986

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.

Audience:

Audience is varied: for some a first course in presenting mathematical 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.

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Course Coordinator:
Paul Ponomarev

Spring, 1986

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.

Audience:

Anyone interested in geometry. Mathematics majors, and undergraduate or graduate majors in mathematics education.

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:
Arno Cronheim

Spring, 1986

Mathematics 575 | 5 cr. | Combinatorial Mathematics and Graph Theory
W, Sp

Prerequisite:

Mathematics 568.

Catalog Description:

Some classical puzzles of recreational mathematics: matching theory, graph theory, network flows, and optimization; enumeration techniques; combinatorial designs and coding theory.

Purpose of Course:

The purpose of this course is to acquaint the student with some aspects and applications of modern combinatorial theory; in particular, to communicate the meaning of the word "combinatorial" and to develop the student's facility for dealing with discrete and essentially 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.

Audience:

In addition to math majors, there will be students from CIS, education, and miscellaneous Arts and Sciences majors. The mathematical background and ability of the students varies through a wide spectrum. This nonuniformity creates some problems -- but all students seem to benefit from the course.

Text:

Introductory to Combinatorial, Bose and Manvel

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, 1986

DEPARTMENT OF MATHEMATICS
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Mathematics 578 A | 5 cr. | Discrete Mathematical Models

Prerequisite:

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

Catalog Description:

Analysis and solution of various applied problems using discrete mathematical models; methods used include graph theory, linear optimization, Markov chains and queues.

Purpose of Course:

1. To introduce the mathematical structures and develop the mathematics appropriate for discrete modeling.
2. To demonstrate and to encourage use of computers in solving mathematical problems
3. To give students a modeling experience with a real world application for which they can construct a model which, through experimentation, can be used to explore possible solutions to the problem.
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.

Audience:

Almost exclusively secondary mathematics/science education majors.

References:

Mathematical Modeling, Maki & Thompson
Discrete Mathematical Models, Roberts, F.
Applying Mathematics, Burghes, Huntly & McDonald
Finite Mathematics, Kemeny, Schlieffer, Thompson & Snell
Markov Chains, Kemeny & Snell
Matrix Methods in Urban & Regional Analysis, Rogers, A.

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.

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Course Coordinator:
Tom Ralley

Spring, 1986

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

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.

Audience:

The audience is primarily junior and senior majors in mathematics and mathematics education. Sometimes a few students will develop especially well and we have added small seminars to the course for these students in the winter and/or spring quarters. Instructors need to watch for students who should be moved to H590 early in autumn quarter.

Text:

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

Topics List

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.

Course Coordinator:
Daniel Shapiro
Spring, 1986

DEPARTMENT OF MATHEMATICS
THE OHIO STATE UNIVERSITY
231 WEST EIGHTEENTH AVENUE
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Mathematics H590	5 cr.	Algebraic Structures I
H591	3 cr.	Algebraic Structures II
H592	3 cr.	Algebraic Structures III

Prerequisite:

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

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

H592 - H591 with grade of C or better or with 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 H590.

H592:

Continuation of H591; further topics in group and field theory and their interrelation; Galois theory.

Audience:

The students are our strongest undergraduates. They will have had some prior exposure to formal argument and proof. This sequence continues the axiomatic development of mathematics and provides a general framework for students to grasp essential algebraic concepts. Problems and examples are emphasized.

Text:

Topics in Algebra, Herstein, or

Basic Algebra, Jacobson and Blaisdell, or

A Survey of Modern Algebra, 4th edition, Birkhoff and MacLane, (MacMillan).

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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 groups; 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:
Alayne Parson

Spring, 1986

Mathematics 601 A | 5 cr. | Mathematical Methods in Science I

Prerequisite:

15 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.

Audience:

The students are principally well-motivated first year graduate students in engineering who are Ph.D bound. Many are from Electrical Engineering and Engineering Mechanics, but a wide variety of engineers and scientists may be found.

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, 1986

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

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 last 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.

Audience:

The students are principally well-motivated first year graduate students in engineering who are PhD bound. Many are from Electrical Engineering and Engineering Mechanics, but a wide variety of engineers and scientists may be found.

Follow-up Course:

Math 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. Poissons'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.

Remarks: 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, 1986

Mathematics 604 | 3 cr. | Introduction to Continuous Applied Mathematics I
A

Prerequisite:

Mathematics 255 or 415 or 556

Catalog Description:

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

Follow-up Course:

Math 605

Text:

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

Topics:

The theoretical aspect of this course centers around qualitative phase plane analysis of autonomous systems. There 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.

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For further information see:
Ted Scheick or
B. Wyman

Spring, 1986

Mathematics 605 W

3 cr.

Introduction to Continuous Applied Mathematics II

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:

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 nonhomogenous 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 L 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.

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.

For further information see:
Ted Scheick or
B. Wyman

Spring, 1986

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.

6. Finite element methods in 1 and, if time permits, 2 space dimensions for elliptic equations. Application to parabolic and hyperbolic equations if time permits

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For further information see:
Ted Scheick

Spring, 1986

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

Su, Au, Wi, Sp

Prerequisite:

1 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 cr. hrs. with written permission of dept.

Audience:

Designed for In-Service teachers.

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 dept. This decimal subdivision is graded S/U.)

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For further information see:
Jim Leitzel

Spring, 1986

Mathematics 611 — 4 cr. — Geometric Linear Algebra
W 88

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.

Audience:

Recommended for secondary school teachers. This course is a required core course in the Masters of Arts program.

Text:

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

Core Courses Offered Au 86 - Su 89:

Au 86:	613; 615	Au 87:	612	Au 88:	615
Wi 87:	621	Wi 88:	611; 614	Wi 89:	611
Sp 87:	612; 614	Sp 88:	615	Sp 89:	613
Su 87:	613; 615	Su 88:	614; 621	Su 89:	612; 615

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For further information see:
Jim Leitzel

Spring, 1986

Mathematics 612 Sp 87 (5 classes for 8 weeks) Au 87 Su 89	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.

Audience:

Recommended for secondary school teachers. This course is a required core course in the Masters of Arts program.

Text:

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

Core Courses Offered Au 86 - Su 89:

Au 86:	613; 615	Au 87:	612	Au 88:	613; 615
Wi 87:	621	Wi 88:	611; 614	Wi 89:	621
Sp 87:	612; 614	Sp 88:	615	Sp 89:	612; 614
Su 87:	613; 615	Su 88:	614; 621	Su 89:	613; 615

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For further information see:
Jim Leitzel

Spring, 1986

Mathematics 613 4 cr. Number Theory and Algebra

A 86
Su 87 (5 classes for 8 weeks)
Au 88
SU 89

Prerequisite:

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

Catalog Description:

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

Audience:

Recommended for secondary school teachers. This course is a required core course in the Masters of Arts program.

Text:

A Concrete Introduction to Higher Algebra, Childs & Porter.

Core Courses Offered Au 86 - Su 89:

Au 86:	613; 615	Au 87:	612	Au 88:	613; 615
Wi 87:	621	Wi 88:	611; 614	Wi 89:	621
Sp 87:	612; 614	Sp 88:	615	Sp 89:	612; 614
Su 87:	613; 615	Su 88:	614; 621	Su 89:	613; 615

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For further information see:
Jim Leitzel

Spring, 1986

Mathematics 614 Sp 87 WI 88 Su 88 Sp 89	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.

Audience:

Recommended for secondary school teachers. This course is a required core course in the Masters of Arts program.

Text:

Numerical Analysis, Burden, Faires & Reynolds.

Core Courses Offered Au 86 - Su 89:

Au 86:	613; 615	Au 87:	612	Au 88:	613; 615
Wi 87:	621	Wi 88:	611; 614	Wi 89:	621
Sp 87:	612; 614	Sp 88:	615	Sp 89:	612; 614
Su 87:	613; 615	Su 88:	614; 621	Su 89:	613; 615

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For further information see:
Jim Leitzel

Spring, 1986

Mathematics 615 4 cr. Foundations of Calculus

Au 86
Su 87
Sp 88
Au 88
Su 89 (5 classes for 8 weeks)

Prerequisite:

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

Catalog Description:

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

Audience:

Recommended for secondary teachers. This course is a required core course in the Masters of Arts program.

Text:

Advanced Calculus, Fulks, or

A First Course in Real Analysis.

Core Courses Offered Au 86 - Su 89:

Au 86:	613; 615	Au 87:	612	Au 88:	613; 615
Wi 87:	621	Wi 88:	611; 614	Wi 89:	621
Sp 87:	612; 614	Sp 88:	615	Sp 89:	612; 614
Su 87:	613; 615	Su 88:	614; 621	Su 89:	613; 615

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For further information see:
Jim Leitzel

Spring, 1986

Mathematics 616 | 4 cr. | Numerical Methods in Actuarial Mathematics
A (2 2-hr 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 in the section on numerical methods in the Part 3 Examination of the Society of Actuaries and the Casualty Actuarial Society. The course is required for the undergraduate major in actuarial science.

Audience:

Mostly undergraduate and graduate students in mathematics and actuarial science. Most classes have some students from the actuarial community in Columbus.

Text:

Numerical Analysis, Burden, R. L., Faires, J. D., and Reynolds, A. C.

Graduation (Society of Actuaries study note) is a useful reference.

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, 1986

Mathematics 618 3 cr. Theory of Interest
Sp (2 1 1/4 hr. 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. This course includes the material on the mathematics of compound interest in the Part 4 examinations of the various actuarial organizations. The course is required for the undergraduate major in actuarial science.

Audience:

Mostly undergraduate and graduate students in mathematics and actuarial science. Most classes have some students from the actuarial or finance communtities in Columbus.

Text:

The Theory of Interest, S. G. Kellison.

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.

For further information see:
Robert Brown

Spring, 1986

DEPARTMENT OF MATHEMATICS
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Mathematics 621 | 4 cr. | Probability

W 87
Su 88
Wi 89

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.

Audience:

Recommended for secondary school teachers. This course is a required core course in the Masters of Arts program.

Core Courses Offered Au 86 - Su 89:

Au 86:	613; 615	Au 87:	612	Au 88:	613; 615
Wi 87:	621	Wi 88:	611; 614	Wi 89:	621
Sp 87:	612; 614	Sp 88:	615	Sp 89:	612; 614
Su 87:	613; 615	Su 88:	614; 621	Su 89:	613; 615

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For further information see:
Jim Leitzel

Spring, 1986

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

A: 630 (2 1 1/4 hr. classes)
W: 631 (2 1 1/4 hr. classes)
Sp: 632 (2 1 1/4 hr. classes)

Prerequisite:

Mathematics 616, 618, and Statistics 520 or equivalent; or permission of instructor.

Catalog Description:

630:

Mortality functions and laws of mortality; continuous and varying annuities; insurances and insurances as integrals; calculation of reserves.

631:

Stationary population theory, multiple integration and population theory, multi-life contingencies, compound contingencies.

632:

Multiple integration and multiple decrements, associated single decrements, primary and secondary decrements; topics of current interest in life and casualty contingencies.

Purpose of Course:

This course is designed to introduce students to the mathematical content of the theory of life contingencies. The course includes the material on life contingenies in the Part 4 Examination of the Society of Actuaries. The course is required for the undergraduate major in actuarial science.

Audience:

Undergraduate majors in actuarial science and graduate students interested in actuarial science. Most classes have some students from the actuarial community in Columbus.

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 Part 4 examination.

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For further information see:
Robert Brown

Spring, 1986

Mathematics 634 4 cr. Linear Mathematical Models
A, 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 resource allocation and product output.

Audience:

This course is a service course primarily for advanced undergraduates and first year graduates in agricultural economics. Some students from industrial and systems engineering, geography, and other agricultural fields have taken this course.

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 Grawoig, (Addison-Wesley)

Topics List

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

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For further information see:
Bostwick Wyman

Spring, 1986

Mathematics 635 Su | 3 cr. | Game Theory

Prerequisite:

Mathematics 568, or permission of department.

Catalog Description:

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

Audience:

The audience is mixed. Some students are mathematics graduate students and others are students in business administration and accounting. The general level is high.

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.

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For further information see:
Charles Saltzer

Spring, 1986

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.

Audience:

Designed primarily for students beginning a graduate program in Mathematics.

Topics List

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.

V. Metric Spaces.

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For further information see:
Henry Glover

Spring, 1986

Mathematics 645
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.

Follow-up Courses:

No specific follow-up.

Audience:

Upper division undergraduate mathematics majors; beginning MA and MS students.

Text:

Set Theory, Pinter; or similar.

Topics:

I. Basic formalisms (with examples from undergraduate topics)
   A. Sets
   B. Relations
   C. Functions
   D. Logic
   E. Proof

II. Set theoretic concepts
   A. Mappings
   B. Transformations of a set (e.g. permutations)
   C. Composition Tables
   D. 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, 1986

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.)

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For further information see:
Tim Carlson

Spring, 1986

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

A: 648
W: 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 introduction to the main areas of mathematical 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.

Audience:

Mix of graduate and undergraduate students from mathematics, philosophy and computer science.

Text:

A Mathematical Introduction to Logic, Enderton.

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. Introduction 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 statement 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, 1986

Mathematics	651	4 cr. each	Introduction to Real Analysis I
	652		Introduction to Real Analysis II
	653		Introduction to Real Analysis III

A: 651
W: 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.

Audience:

Mathematics M.S. students, Statistics Ph.D. students, Mathematics Ph.D. students with incomplete prerequisites, and a few others. Generally the students will need 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, 1986

Mathematics 654 | 3 cr. | Complex Variables
Su

Prerequisite: Permission of department.

Not open to students with credit for 514 or 552.

Catalog Description:

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

Purpose 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.

Audience:

Mathematics Head-Start Graduate students, graduate students in engineering, occasional undergraduates. They are intelligent people who recognize their need to learn the subject matter.

Text: 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 1	2 classes
5. Geometry, bilinear transformations	2 classes
6. Schwarz-Christoffel transformation	1 1/2 classes
7. Applications	1 1/2 classes
8. Review and second test	2 classes
II. Second Term	
1. Complex integration	3 classes
2. Series Representations	3 classes
3. Review and Test 3	2 classes
4. Residue Theory	6 classes
5. Review and Test 4	2 classes

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For further information see:
Frank Carroll

Spring, 1986

Mathematics 655 — 4 cr. each — Elementary Topology I
656 — Elementary Topology II
657 — Elementary Topology III

A: 655
W: 656
Sp: 657

Prerequisite:

Permission of department.

Catalog Description:

655:

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

656:

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

657:

Continuation of 656; fundamental group and covering spaces.

Purpose of Course:

A core sequence in the Mathematics graduate program. This is a first course in Topology.

Audience:

Primarily first or second year students in the Mathematics graduate program.

Text:

655: J. Munkres, Topology, Prentice Hall

656: W. Massey, Algebraic Topology: An Introduction, Springer-Verlag

657: J. Munkres, Elements of Algebraic Topology, Addison Wesley

Topics:

1. Metric Spaces
2. General Spaces
3. Fundamental group and covering spaces
4. Homology

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For further information see:
Henry Glover

Spring, 1986

Mathematics 665
666

4 cr. each

Modern Mathematical Methods in Relativity Theory I, II

W: 665
Sp: 666

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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.

666:

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

Purpose of Course:

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. Homework problems constitute an integral part of this course. A course in modern mathematical methods for waves, signals, and quanta would be a good next course.

Audience:

Advanced undergraduates as well as graduate students in astronomy, mathematics and physics as well as engineering and geodetic science. All students are usually highly motivated. Students must be familiar with calculus of several variables, and Newtonian mechanics. Linear algebra is desirable but not necessary.

Text:

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

Topics:

665:

Geometry in Minkowski space-time; physical interpretations; acceleration and thermal ambience; tensors and multilinear algebra; exterior calculus; manifolds; Lie derivatives; parallel transport; torsion; curvature; Cartan's two-structural equations.

666:

Stress-energy tensor; relativistic Euler equations; Einstein field equations; solutions to the field equations: spherical stars, gravitational collapse, black holes, homogeneous cosmologies; Hamilton-Jacobi theory in curved space-time; local-global properties; space-time symmetries, entropy.

Topics List

Math 665:

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

II. Tensor algebra
(13 lectures)
1. Chapter 2 in M, T, & W.
2. Chapter 3 in M, T, & W.
3. Chapter 4 in M, T, & W.

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

Math 666:

I. Relativistic Euler equations of motion.
Chapter 5.1 - 5.10 in M, T, & W.
Chapter 22.1 - 22.3 in M, T, & W.

II. Einstein's field equations.
Chapter 16.1 - 16.2 in M, T, & W.
Chapter 17.1 - 17.4 in M, T, & W.

III. Solutions to the combined Einstein-Euler equations and their properties.
Chapter 23 in M, T, & W.

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

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

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

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For further information see:
Ulrich Gerlach

Spring, 1986

Mathematics 669 | 5 credits | 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.

Purpose of Course:

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

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

Audience:

Primarily students just beginning their graduate program in Mathematics.

Text:

No text is completely appropriate.

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For further information see:
Arnold E. Ross

Spring, 1986

Mathematics 670 671 672 — 5 cr. each — Algebra I, Algebra II, Algebra III

A: 670
W: 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, linear programming, orthogonality.

672:

Continuation of 671; quadratic forms, finite fields, various applications.

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.

Audience:

Mostly entering M.S. students. Some students in the M.A. program take this course as an elective. Occasionally Ph.D. candidates in Education or students interested in applications of algebra will enroll.

Text:

Brown-Wyman mimeographed notes.

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 linear 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:
Jim Leitzel

Spring, 1986

Mathematics 674 | 3 cr. | Survey of Combinatorial Mathematics
Su, Sp

Prerequisite:

Mathematics 569

Catalog Description:

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

Audience:

The audience for Summer quarter is primarily Mathematics Head Start Graduate Students.

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.

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For further information see:
Tom Dowling

Spring, 1986

Mathematics 675 676 677 — 4 cr. each

Applied Discrete Mathematics I
Applied Discrete Mathematics II
Applied Discrete Mathematics III

A: 675
W: 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 prohability, 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, 1986

Mathematics 701 | 5 cr. | Mathematical Methods in Science III
Sp

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 on file in the library.

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

Audience:

The students are principally well-motivated first year graduate students in engineering who are PhD bound. Many are from Electrical Engineering and Engineering Mechanics, but a wide variety of engineers and scientists may be found.

Text:

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 constraints.

3. Transversality conditions.

4. Geodesics.

5. Hamiltons equations.

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

Tensor Analysis

1. Definitions, 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, 1986

Mathematics 702 | 3 cr. | Integral Equations and Eigenvalue Problems
Au Qtr.

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.

Audience:

Beginning graduate students in mathematics and graduate students in science and engineering.

Text:

Integral Equations, Triomi, or Integral Equations, Hochstadt

Topics:

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

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For further information see:
Charles Saltzer

Spring, 1986

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

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. The two courses, 702 and 703, should be considered as a unit.

Audience:

Beginning graduate students in mathematics and graduate students in science and engineering.

Text:

Integral Equations, Triomi, or Integral Equations, Hochstadt

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For further information see:
Charles Saltzer

Spring, 1986

Mathematics 705 | 3 cr. | Special Functions
Wi Qtr.

Prerequisite:

Mathemtics 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:

Audience:

Text:

Topics:

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For further information see:

Spring, 1986

Mathematics 707 | 3 cr. | Theoretical Numerical Analysis I
Au Qtr.

Prerequisite:

Mathematics 651 and 671, or 602, or equiv, 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:

Audience:

Text:

Topics:

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For further information see:

Spring, 1986

Mathematics 708
Wi Qtr.

3 cr.

Theoretical Numerical Analysis II

Prerequisite:

Mathematics 707

Catalog Description:

Continuation of 707

Purpose of Course:

Audience:

Text:

Topics:

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For further information see:

Spring, 1986

Mathematics 709 | 3 cr. | Theoretical Numerical Analysis III
Sp Qtr.

Prerequisite:

Mathematics 708

Catalog Description:

Continuation of 708

Purpose of Course:

Audience:

Text:

Topics:

For further information see:

Spring, 1986

Mathematics 710 4 cr. Projective Geometry
SU Qtr. (alternate years)

Prerequisite:

Mathematics 671 or permission of department

Catalog Description:

Desarguesian spaces; lattice-theoretic characterization; introduction of coordinates; fundamental theorem on collineations; correlations.

Purpose of Course:

To show that classical projective geometry is still a rich source of problems, and examples, for modern geometry and combinatorics.

Audience:

Students interested in geometry, combinatorics, and group theory.

Text:

Hughes & Piper, Projective Planes, Springer

Topics:

See description; plus short introduction to Non-Desarguesian planes.

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For further information see:
Arno Cromheim

Spring, 1986

Mathematics 722 | 4 cr. | Theory of Probability I
Au Qtr.

Prerequisite:

Mathematics 653

Catalog Description:

Fundamentals of measure theory, general probability distributions, Lebesque integral, and conditional expectations.

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.

Audience:

Mathematics Ph.D students, Statistics Ph.D students, and some others.

Text:

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, 1986

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

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 of 723, to introduce them to the modern theory of stochastic processes.

Audience:

Mathematics Ph.D students, Statistics Ph.D students, and some others.

Text:

To be announced

Topics:

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

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For further information see:
Neil Falkner

Spring, 1986

Mathematics 724 4 cr. Theory of Probability III
Sp Qtr.

Prerequisite:

Mathematics 723

Catalog Description:

Continuation of 723

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.

Audience:

Mathematics Ph.D students, Statistics Ph.D students, and some others.

Text:

To be announced.

Topics:

Further topics in stochastic processes, primarily selected from the following list: stationary processes, Poisson process, birth and death processes, random walk, Brownian motion, Markov processes.

Follow-up Course:

Math 939: Topics in Probability Theory

For further information see:
Neil Falkner

Spring, 1986

Mathematics 741
Au Qtr.

3 cr.

Mathematical Foundations of the Design and Use of Automatics Systems I

Prerequisite:

Graduate standing or permission of the department

Catalog Description:

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

Purpose of Course:

Audience:

Text:

Topics:

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For further information see:

Spring, 1986

Mathematics 742 | 3 cr. | Mathematical Foundations of the Design and use of Automatic Systems II

Wi Qtr.

Prerequisite:

Mathematics 741 and graduate standing or permission of the department

Catalog Description:

Continuation of 741

Purpose of Course:

Audience:

Text:

Topics:

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For further information see:

Spring, 1986

Mathematics 750, Su, Au Qtr. 5 cr. Real Analysis I
751, Wi Qtr. II
752, Sp Qtr. 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:

Audience:

Math Grad Students

Text:

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

Topics:

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

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For further information see:
Bill Davis

Spring, 1986

Mathematics 753 | 5 cr. | Introduction to Complex Analysis I
Wi Qtr.

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.

Audience:

Students who are comfortable with comlex variables, real analysis, and topology at or near the proficiency level.

Text:

(1986), Complex Analysis, A Functional Analysis Approach, D.H. Luecking and L.A. Rubel, (Springer).

Topics:

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.

NOTE: The sequence 753-754 is offered in the Winter and Spring of even numbered years. It will not be offered in 1987. 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."

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For further information see:
Frank Carroll

Spring, 1986

Mathematics 754 | 5 cr. | Introduction to Complex Analysis II
Sp Qtr.

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.

Audience:

Students with proficiency level mastery of complex variables and (master's) analysis.

Text:

(1986) Complex Analysis, L.V. Ahlfors, (McGraw-Hill)
Conformal Invariants, L.V. Ahlfors, (McGraw-Hill)

Topics:

Those listed above plus applications of Schwarz's lemma, capacity, harmonic measures, Riemann surfaces.

NOTE: The sequence 753-754 is offered in the Winter and Spring of even numbered years. It will not be offered in 1987. 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, 1986

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Mathematics 760 | 3 cr. | Ordinary Differential Equations I
Au Qtr.

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.

Audience:

Graduate students in mathematics and the applied sciences.

Text:

Nonlinear Oscillations, Dynamical Systems, and Bifurcations of Vector Fields, J. Guckenheimer and P. Holmes.

Description:

This sequence is aimed at the development of the modern theory and application so O.D.E.'s. A brief review of classical qualitative theory (phase plane techniques, Poincare-Bendixson theorems, etc.) will be given.

The topics to be covered include: Linearization theorems, Floquet theory, existence of periodic solutions, bifurcations, topics from modern dynamical systems theory including chaos.

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

For further information see:
Greg Forest or
Ted Scheick

Spring, 1986

Mathematics 761 | 3 cr. | Ordinary Differential Equations II
Wi Qtr.

<u>Prerequisite</u>:

Mathematics 760

<u>Catalog Description</u>:

Continuation of 760.

<u>Purpose of Course</u>:

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.

<u>Audience</u>:

Graduate students in mathematics and the applied sciences.

<u>Text</u>:

<u>Nonlinear Oscillations, Dynamical Systems, and Bifurcations of Vector Fields</u>, J. Guckenheimer and P. Holmes.

<u>Topics</u>:

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

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For further information see:
Greg Forest or
Ted Scheick

Spring, 1986

Mathematics 763
Au Qtr.

3 cr.

Partial Diffrential Equations and Their Applications I

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 brief 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 characteristics, 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.

Audience:

Graduate students in mathematics and applied sciences.

Text:

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

Shock Waves and Reaction-Diffusion Equations, J. Smaller

Linear and Nonlinear Waves, G. Whitham

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For further information see:
Greg Forest

Spring, 1986

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

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.

Audience:

Graduate students in mathematics and applied sciences.

Text:

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

Shock Waves and Reaction-Diffusion Equations, J. Smaller

Linear and Nonlinear Waves, G. Whitham

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For further information see:
Greg Forest

Spring, 1986

Mathematics 767 | 4 cr. | Introduction to the Theory of Approximation I
768 | | Introduction to the Theory of Approximation II

A: 767
W: 768

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:

A continuation of 767.

Purpose of Course:

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

Audience:

Graduate students in the department of Mathematics and Computer and Information Science.

Text:

An Introduction to the Approximation of Functions, T.J. Rivlin

A Practical Guide to Splines, De Boor

Approximation of Functions, Lorentz

Topics:

Same as the catalog description with the addition of splines

For further information see:
Ranko Bojanic

Spring, 1986

Mathematics 770 | 5 cr. | Algebra I
Au Qtr.

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:

Audience:

Text:

Topics:

See catalog description above.

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For further information see:

Spring, 1986

Mathematics 771
Wi Qtr.

5 cr.

Algebra II

Prerequisite:

Mathematics 770 or equivalent with permission of the department

Catalog Description:

A continuation of 770

Purpose of Course:

Audience:

Text:

Topics:

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For further information see:

Spring, 1986

Mathematics 772 4 cr. Algebra III
Sp Qtr.

Prerequisite:

Mathematics 771 or equiv with permission of the department

Catalog Description:

A continuation of 771

Purpose of Course:

Foundations of Algebra for Ph.D. level mathematics.

Audience:

Prospective Ph.D. candidates.

Text:

Possibilities are: Algebra, Lang
Algebra I, Jacobson
Algebra, Van der Waerden

Topics:

Field extensions, Galois theory, separability, Transcendence degree, finite fields, algebraic closure.

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For further information see:
Robert Gold

Spring, 1986

Mathematics 775 Au Qtr. 5 cr. Combinatorics & Graph Theory I
776 Wi Qtr. Combinatorics & Graph Theory II
777 Sp Qtr. Combinatorics & Graph Theory III

Prerequisite:

775: Mathematics 672
776: Mathematics 775
777: Mathematics 776

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:

Audience:

Text:

Topics:

See catalog description above.

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For further information see:

Spring, 1986

Mathematics 776 | 5 cr. | Combinatorics and Graph Theory II
Wi Qtr.

Prerequisite:

Mathematics 775

Catalog Description:

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

Purpose of Course:

Audience:

Text:

Topics:

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For further information see:

Spring, 1986

Mathematics 777
Sp Qtr.

5 cr.

Combinatorics and
Graph Theory III

Prerequisite:

Mathematics 776

Catalog Description:

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

Purpose of Course:

Audience:

Text:

Topics:

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For further information see:

Spring, 1986

Mathematics 780 3 cr. Number Theory I
Au Qtr.

Prerequisite:

Mathematics 772

Catalog Description:

Algebraic number theory.

Purpose of Course:

Introduction to algebraic number theory in the classical language with emphasis on examples.

Audience:

Graduate students intending to do further work in number theory, group theory, ring theory, combinatories, algebraic topolgy, algebra, geometry, etc.

Text:

NONE

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

Topics:

Fundamental Theorem of Ideal Theory, decompositions 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, Hilberts's ramification theory in Galois extensions, valuations, and completions.

Emphasis on examples from quadratic fields and cyclotomic fields.

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For further information see:
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Summer, 1986

Mathematics 781 3 cr. Number Theory II
Diophantine Equations

Prerequisite:

Mathematics 780

Catalog Description:

Continuation of Mathematics 780

Purpose of Course:

Audience:

Text:

Topics List

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

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

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

IV) Selected Topics (by Instructor) (3.5 wks)
  e.g.,
  a) Modular forms over $SL_2(Z)$ (E.g. Chap. VII of Serre)
  b) C_n Fields, Tsen-Lang Theorem, Failure of Artin Conjecture (Terjanian), Forms in many variables.
  c) Introducction to Arithmetic Theory of Quadratic Forms over Z (e.g. expanded version of Chap. V of Serre or Chap. II of Milnor-Husemoller)
  d) Introduction to Elliptic Curves of Q (e.g. Chap. 1 of Koblitz)

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Spring 1986

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 judgement. 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.

Audience:

Text:

Lang, Janos, Goldstein, Davenport

Topics List

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

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Spring 1986

Mathematics 851 - WI Qtr. 3 cr. Differential Geometry I
852 - SP Qtr. Differential Geometry II

Prerequisite:

Mathematics 655, 751, and 771.

Catalog Description:

851: Curves, surfaces, fundamental forms, tensors, and connections.
852: Continuation of 851

Purpose of Course:

Audience:

Text:

Topics:

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For further information see:

Spring, 1986

Mathematics 854 | 3 cr. | Lie Groups I
Wi Qtr.

Prerequisite:

Mathematics 651, 751, and 771.

Catalog Description:

Integration on manifolds, Lie groups, classical groups, homogeneous spaces.

Purpose of Course:

Audience:

Text:

Topics:

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For further information see:

Spring, 1986

Mathematics 857 | 3 cr. | Introduction to Functional Analysis I
Au Qtr.

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.

Audience:

Mathematics graduate students. (Occasional students from Statistics, Physics, and Engineering).

Text:

Varies, In 85-86: A Course in Functional Analysis, J. Conway, (Springer-Verlag)

Topics:

Hilbert space, Banach space, locally convex spaces. Examples: Hahn-Banach Theorem, closed graph theorem, Krein-Milman Theorem.

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For further information see:
Gerald Edgar

Spring, 1986

Mathematics 858 | 3 cr. | Introduction to Functional Analysis II
Wi Qtr.

Prerequisite:

Mathematics 857

Catalog Description:

Continuation of 857.

Purpose of Course:

Second quarter of sequence for analysts.

Audience:

Mathematics graduate students

Text:

Varies, In 85-86: A Course in Functional Analysis, J. Conway (Springer-Verlag)

Topics:

Operators (bounded and unbounded). C^* algebras.

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For further information see:
Gerald Edgar

Spring, 1986

Mathematics 859 | 3 cr. | Introduction to Functional Analysis III
Sp Qtr.

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.

Audience:

Mathematics graduate students.

Text:

Varies, In 85-86: No Text.

Topics:

Varies: vector-valued integrals, measures, martingales; extreme points.

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For further information see:
Gerald Edgar

Spring, 1986

Mathematics 860 AU 3 cr. Algebraic Topology I
861 WI Algebraic Topology II
862 SP Algebraic Topology III

Prerequisite:

860: Mathematics 657
861: 860
862: 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 fibration and homotopy theory.

Audience:

Second year graduate students and honor undergraduates.

Text:

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.

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For further information see:
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Spring, 1986

Mathematics 860 3 cr. Algebraic Topology I

Prerequisite:

Mathematics 657

Catalog Description:

Singular homology theory.

Purpose of Course:

Introduce singluar homology together with its basic applications.

Audience:

Honor undergrads plus all grad students in Math.

Text:

Elements of Algebraic Topology, Munknes, James R., Addison-Wesley, 1984.

Topics:

Singular homology and its applications.

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Spring, 1986

Mathematics 861 3 cr. Algebraic Topology II

Prerequisite:

Mathematics 860

Catalog Description:

Continuation of 860; cohomology theory.

Purpose of Course:

Introduce singular cohomology together with applications.

Audience:

Honors undergrad plus all graduate students in Math.

Text:

Elements of Algebraic Topology, Munknes, James R.

Topics:

Singular cohomology, Poincare duality for manifolds applications

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For further information see:
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Spring, 1986

Mathematics 862 | 3 cr. | Algebraic Topology III

Prerequisite:

Mathematics 861

Catalog Description:

Continuation of 860 and 861; fibrations and homotopy theory.

Purpose of Course:

Introduce fibration and homotopy theory.

Audience:

Honors undergrad plus all graduate students in Math.

Text:

Elements of Homotopy Theory, Whitehead, George, Springer - Vevlag, 1978.

Topics:

Fibrations, homotopy theory, homotopy groups.

For further information see:
Henry Glover

Spring, 1986

Mathematics 872 4 cr. Group Theory I
Au Qtr.

Prerequisite:

Mathematics 672 and 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, Fuchsion groups, etc. What (almost) every young mathematician should know about groups.

Audience:

Students aiming for a Ph.D. in group theory, combinatorics, representation theory (Lie theory), topology, number theory, etc.

Text:

Normally, no text is used. Possible texts would include:
Group Theory I, M. Suzuki
Finite Groups, D. Gorenstein
Endliche Gruppen I, B. Huppert

Topics:

1. The normal structure of finite and algebraic groups; the solvable radical; the semisimple layer; the Fitting and generalized Fitting subgroups.

   The local-global principle: local control of fusion, transfer, character theory, cohomology.

   Famous applications (e.g. Zassenhaus groups, CN groups of odd order, Glaubermon's Z^*-Theorem).

For further information see:
Koichiro Harada
Ronald Solomon

Spring, 1986

Mathematics 873 — 4 cr. — Group Theory II
Au Qtr.

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.

Audience:

Same as 872

Text:

Normally, no text is used.

Topics:

1. The classical linear groups and their geometries.

2. BN-pairs and Tits buildings for the classical and exceptional groups.

3. Coxeter groups, Hecker algebras and significance for representation theroy.

4. Ad libitum: sporadic groups, arithmetic groups, Fuchsian groups.

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For further information see:
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Spring, 1986

Mathematics 874 4 cr. Group Theory III
Wi Qtr.

Prerequisite:

Mathematics 873

Catalog Description:

Continuation of 873.

Purpose of Course:

Special topics leading to specific research areas in group theroy or related fields.

Audience:

Depends on choice of topics.

Text:

Normally, no text is used.

Topics:

Many possibilites including:

1. Elliptic modular functions and the Monster group.
2. Representation 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.

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