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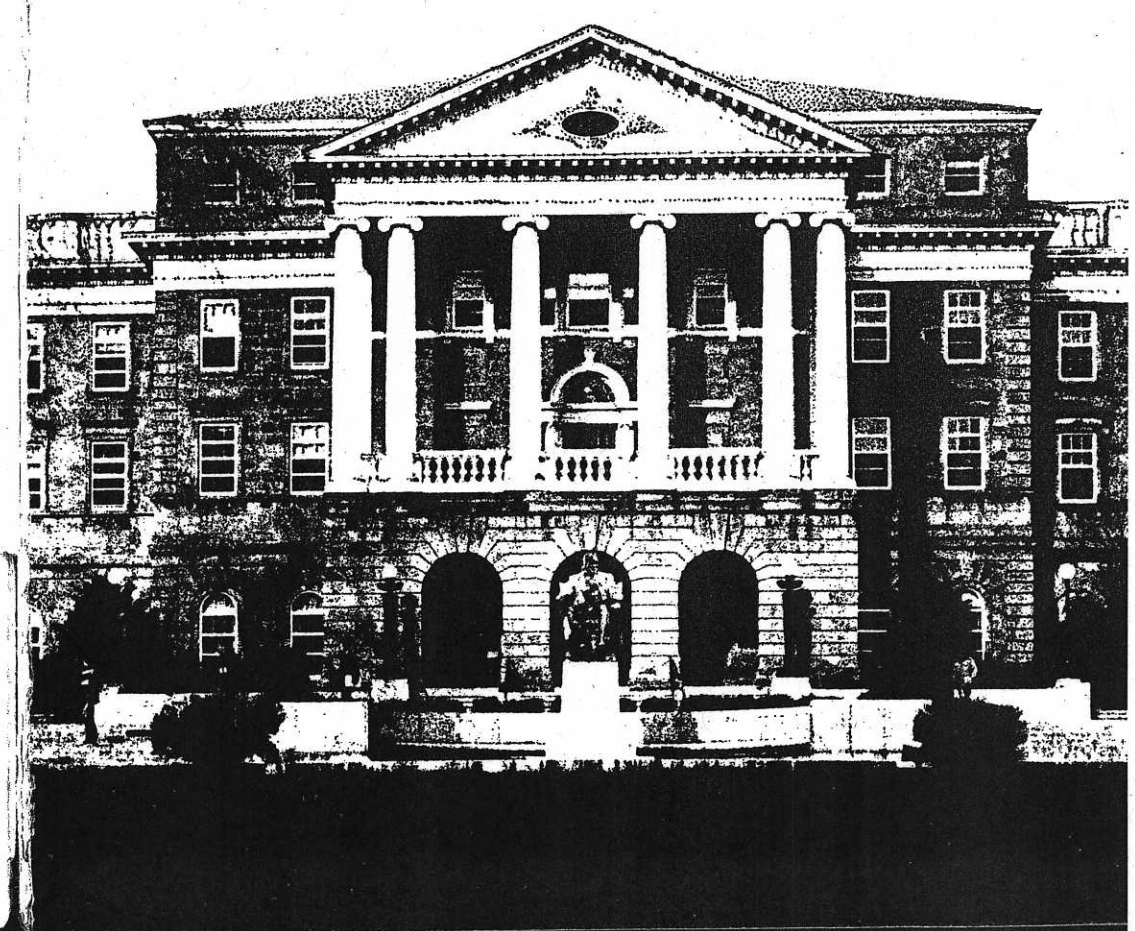
College of Letters and Science 1974-76

Bulletin of the University of Wisconsin-Madison



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339 Kierkegaard to Lagerkvist—Ideas in Scandinavian Literature. (Concurrent with Scand. Std. 426.) Sem; 2 or 3 cr. Mr. Ingwersen.

340 Contemporary Scandinavian Literatures. (Concurrent with Scand. Std. 427.) Sem; 2 or 3 cr. Mr. Vowles.

341 Twentieth Century Drama and Film. (Concurrent with Scand. Std. 428.) Sem; 2-3 cr. Mr. Vowles.

342 Mythology of Scandinavia. (Concurrent with Scand. Std. 429.) Sem; 3 cr. Mr. Ringler, Mr. Ingwersen, Mr. Naess.

SLAVIC LANGUAGES IN TRANSLATION: 577 (CURRICULAR AREA NUMBER)

201 Survey of Nineteenth- and Twentieth-Century Russian Literature. II; 3 cr. Pushkin to Tolstoy; reading and lecture in English. Prereq: Jr st. Mr. Zawacki.

202 Survey of Nineteenth- and Twentieth-Century Russian Literature. II; 3 cr. Dostoevsky to the present, reading and lecture in English. Prereq: Jr st. Mr. Zawacki.

205 The Woman in Russian Literature. Sem; 2 cr. Prereq: Jr st. Mrs. Gasiorowski.

222 Dostoevsky. II; 2 cr. Major works, lecture in English. Prereq: Jr st. Mr. Rosenshield.

224 Tolstoy. Sem; 2 cr. Major works, lecture in English. Prereq: Jr st. Mrs. Gasiorowski.

240 Soviet Literature. Sem; 2 cr. Lecture in English. Prereq: Jr st. Mrs. Gasiorowski.

256 Masterpieces of Russian Drama. Sem; 2 cr. Their social function and literary significance; lecture in English. Prereq: Jr st.

258 Trends in Russian Culture and Literature; Sem; 2 cr. Development of Russian culture within the framework of Russian literature. Prereq: Jr st.

259 Masterpieces of Polish Literature. Sem; 2 cr. Their literary importance and social significance; lecture in English. Prereq: Jr st. Mrs. Gasiorowski.

262 Survey of Western and Southern Slavic Literatures. Sem; 2 cr. Prereq: Jr st. Mr. Thomas.

SPANISH IN TRANSLATION: 580 (CURRICULAR AREA NUMBER)

243 Cervantes' "Don Quixote". Sem; 3 cr. Life and the works of Cervantes; historical developments in sixteenth- and seventeenth-century Spain relating to literature; influence of Cervantes in foreign literature.

255 Spanish and Portuguese Masterpieces in Translation. Sem; 3 cr. Major works of fiction, drama, and poetry.

266 Latin-American Literature in Translation. Sem; 3 cr. Major works of fiction, drama, and poetry.

MATHEMATICS

Professors Bleicher (Chairman), Ahern, Askey, Barwise, Bauman, Beck, Bicknell, Bing, de Boor, Box, Brauer, Brualdi, Bruck, Buck, Cannon, Chover, Conley, Conner, Crowe, Dickey, Fadell, Forelli, Gooding, Gunji, Hall, Harvey, Hellerstein, Husseini, Isaacs, A. Johnson, M. Johnson, Keisler, Kleene, Kuelbs, Kunen, Kurtz, Levin, Levy, McMillan, McQuillan, Meyer, Miles, Moore, Nagel, Ney, Noble, Nohel, Orlik, Osborn, Parter, Passman, Rabinowitz, Rall, Rider, Robbin, Rosser, M. Rudin, W. Rudin, Russell, Schneider, Shea, Shen, Smart, Solomon, Turner, Uhlenbrock, Voichick, Wainger, Wasow, Wilson, Young. Instructors Landauer, Liang.

Mathematics is classified both with the humanities and the sciences. Its position among the humanities is based on the study of mathematics as one of the liberal arts for more than 2,000 years. Far from becoming stagnant, mathematics offers more new and challenging frontiers than at any time in its long history—with totally new fields, requiring new techniques and ideas for exploration.

The place of mathematics among the sciences is well founded. The natural sciences have invariably turned to ma matics for the techniques needed to e plore the consequences of scientific theories. Economists, psychologists, engineers find higher mathematics of in their training and research as a sou for models within their disciplines.

There are many opportunities for the graduate mathematics major in indust business, and secondary school teacl With graduate work in mathematics th individual can take advantage of the demands for people capable of mathe matical research in industry and acac institutions and of teaching at the col and university level. The requirement the mathematics major are flexible en to allow preparation for any of these

Students interested in mathematics s also consider the programs offered b Computer Sciences Department, the tistics Department, the Applied Mathe ics, Engineering and Physics Course, the School of Business in Actuarial Science.

Prerequisites

Four levels of preuniversity competer are specified below. (Levels of comp tence, except superior, are measurec high school preparation and by the p ment examinations described below. Prospective students of mathematics ence, and engineering should achiev vanced mathematical competence (L 3a and 3b) before coming to the Uni so that they may enroll in Mathemati at the start of the freshman year. St with only minimum and intermediate matical competence are strongly adv remove this deficiency by Independe Study or enrolling for the summer se preceding their freshman year.

1. Minimum mathematical competence algebra and arithmetic: an understa of the axioms that underlie arithmeti decimal system and its use in calcul and the definition and elementary pr ties of rational numbers; basic algeb skills, including special products, fa positive integral exponents, and the manipulation of algebraic fractions;

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significance; lecture in English.
: Jr st. Mrs. Gasiorowski.

rvey of Western and Southern Slavic ires. Sem; 2 cr. Prereq: Jr st. mas.

:H IN TRANSLATION:
JRRICULAR AREA NUMBER)

'vantes' "Don Quixote". Sem; 3 cr. the works of Cervantes; historical nents in sixteenth- and seven- entury Spain relating to literature; e of Cervantes in foreign literature.

nish and Portuguese Masterpieces ation. Sem; 3 cr. Major works of rama, and poetry.

i-American Literature in Transla- n; 3 cr. Major works of fiction, nd poetry.

ATICS

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mathematics among the sci- founded. The natural sciences have invariably turned to mathematics for the techniques needed to explore the consequences of scientific theories. Economists, psychologists, and engineers find higher mathematics of value in their training and research as a source for models within their disciplines.

There are many opportunities for the undergraduate mathematics major in industry, business, and secondary school teaching. With graduate work in mathematics the individual can take advantage of the demands for people capable of mathematical research in industry and academic institutions and of teaching at the college and university level. The requirements for the mathematics major are flexible enough to allow preparation for any of these goals.

Students interested in mathematics should also consider the programs offered by the Computer Sciences Department, the Statistics Department, the Applied Mathematics, Engineering and Physics Course, and the School of Business in Actuarial Science.

Prerequisites

Four levels of preuniversity competence are specified below. (Levels of competence, except superior, are measured by high school preparation and by the placement examinations described below.) Prospective students of mathematics, science, and engineering should achieve advanced mathematical competence (Levels 3a and 3b) before coming to the University so that they may enroll in Mathematics 221 at the start of the freshman year. Students with only minimum and intermediate mathematical competence are strongly advised to remove this deficiency by Independent Study or enrolling for the summer session preceding their freshman year.

1. Minimum mathematical competence. From algebra and arithmetic: an understanding of the axioms that underlie arithmetic, the decimal system and its use in calculation, and the definition and elementary properties of rational numbers; basic algebraic skills, including special products, factoring, positive integral exponents, and the manipulation of algebraic fractions; setting up and solving linear equations and inequalities; from geometry: axioms, theorems, and proofs of theorems concerning straight lines, triangles, and circles; graphing of linear equations and the solutions and geometric significance of systems of two linear equations; mensuration (area and volume) formulas for common two- and three-dimensional figures.

2. Intermediate mathematical competence. The topics of level 1, together with: setting up and solving quadratic equations and inequalities, complex numbers, rational exponents, progressions, graphing of circles and quadratic polynomials, definition and elementary properties of logarithms.

3. a. Advanced mathematical competence—Algebra. The topics of Levels 1 and 2, together with: algebra of polynomial and rational functions; the function concept; theory of polynomial equations, including the remainder and factor theorems; solution of simultaneous linear equations; equations and graphs of lines and circles; infinite geometric progressions; mathematical induction and the binomial theorem.

3. b. Advanced mathematical competence—Trigonometry. The topics of Levels 1 and 2, together with: the function concept; trigonometric functions of a real number together with their basic properties and graphs; trigonometric equations and identities; geometric significance of the trigonometric functions and elementary applications; trigonometric form of complex numbers and DeMoivre's Theorem.

4. Superior mathematical competence. Some high schools may find it possible to offer topics to specially selected students who have already achieved advanced mathematical competence. For example, courses in probability and statistics, analytic geometry, calculus, or topics in modern algebra are suitable for high school students of superior ability. Students who have completed a program of study beyond advanced mathematical competence will be individually placed by the department (high school records and recommendations, the Advanced Placement Examination given by the College Entrance Examination Board, and the placement and advanced place-

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ment examinations given at the University may be taken into consideration).

Placement

Each entering student (freshman or transfer student without previous college mathematics) who intends to take any mathematics course in the University is required to take the placement examinations in mathematics before registration. Placement in any given course is not guaranteed on the basis of the high school record alone; placement in the course appropriate to the student's needs and competence will be made by the Department of Mathematics on the basis of both high school record and placement scores.

Major

Major requirements are under study and may be revised. New requirements will be available from the undergraduate advising secretary in room 218 Van Vleck Hall when available.

To be accepted as a major in mathematics a student must complete Math. 221, 222, 223 (or equivalent sequence) with a grade-point average of 2.5 or better. (However, a somewhat higher grade-point average is advisable to major in mathematics.) A prospective major will ordinarily take a year course in Physics during his sophomore year, preferably Physics 207-208. Majors are required to earn at least 18 credits in mathematics courses numbered above 303. These credits must be distributed so as to satisfy the following overlapping conditions:

1. At least 3 credits in Algebra, 3 credits in Analysis, and 3 credits in Geometry or Topology. (Actuarial students may substitute Math. 313 for the Geometry-Topology requirement.) The following list indicates which courses may normally be used to satisfy this requirement:
   Algebra: 443, 541, 542, 567, 568.
   Analysis: 321, 322, 417, 419, 431, 521, 522, 561, 623, 629, 632.
   Geometry-Topology: 461, 462, 551, 552, 561, 563, 565.
2. At least two one-year sequences from the following list:
   a. Math. 309-310 (Statistics)
   b. Math. 321-322 (Applied Math. Analysis)
   c. Math. 431-632 (Probability)
   d. Math. 513-514 (Num. Analysis)
   e. Math. 521-522 (Advanced Calculus)
   f. Math. 541-542 (Modern Algebra)
   g. Math. 567-568 (Number Theory)
   h. Any two of the following courses: Math. 461 (College Geometry I), Math. 462 (College Geometry II), Math. 551 (Topology), Math. 552 (Algebraic Topology), Math. 561 (Differential Geometry), Math. 563 (Projective Geometry), Math. 565 (Convex Figures and Inequalities).
3. At least one of the following one-year sequences:
   Math. 521-522 (Advanced Calculus),
   Math. 541-542 (Modern Algebra).

   Students who plan to take graduate work in mathematics should take 521-522, 541-542, and 551. They should also acquire a reading knowledge of two foreign languages as early as possible. For mathematics the important languages are Russian, German, French and possibly, Italian.

   Students in the Secondary School Program of the School of Education who major in mathematics must earn a 2.5 grade-point average in their advanced mathematics courses and meet these requirements:

1. Four years of high school mathematics and satisfactory placement scores or Math. 112 and 113 (Algebra and Trigonometry)
2. Take the following or an equivalent sequence 221, 222, 223 (Cal. and Analytic Geometry)
3. a, b, and c
   a. 541-542 (Modern Algebra)
   b. Choice of
   461 (College Geometry I) or
   565 (Convex Figures and Inequalities)
   c. Electives (9 credits) chosen from: not more than one course from Math. 240 (Introductory Finite Mathematics), Math. 251 (Topics in College Math.), Math. 320 (Linear Mathematics), or announced equivalent; any mathematics course numbered above 302; not more than one Computer Science course numbered 301 and above.
4. Education courses:
   Professional education courses
   Curric. 163 (Teaching of Mathematics), 2 credits. Consult the *School of Education Bulletin* for further details.

Mathematics Honors Courses

Honors credit is offered in the honors sections of Mathematics 221, 222, 223, 320.

L&S General Honors Program

To earn the B.A. or B.S. with honors, majors in mathematics must complete (a) the L&S general course degree requirements, (b) the General Honors Program requirements, and (c) the junior-senior honors curriculum in the department.

Junior-senior honors curriculum. Honors majors must complete the honors courses 521-522 and 541-542, together with at least a one-semester honors course in geometry or topology. They must in the senior year take 681-682 (Senior Honors Thesis). Alternatives to the Senior Thesis are sometimes available. Details should be obtained from the department honors adviser during the student's junior year. Honors credit will be offered in the following advanced courses: 419, 431, 521, 522, 541, 542, 551, 552, 561, 563, 565, 567, 568, 623, 632, 629. In addition, any graduate course taken by an undergraduate will carry honors credit.

Honors in the Major

Students majoring in mathematics who are not honors candidates may earn honors in the major by satisfactorily completing the junior-senior honors program in mathematics described above.

600 (CURRICULAR AREA NUMBER)

Elementary Courses

The courses 221, 222, 223 form a three-semester sequence in calculus and analytic

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ast two one-year sequences from following list:
lath. 309-310 (Statistics)
lath. 321-322 (Applied Math. Analysis)
lath. 431-632 (Probability)
lath. 513-514 (Num. Analysis)
lath. 521-522 (Advanced Calculus)
ath. 541-542 (Modern Algebra)
lath. 567-568 (Number Theory)
ny two of the following courses:
1. 461 (College Geometry I), Math. 462
lege Geometry II), Math. 551 (Topol-
, Math. 552 (Algebraic Topology),
1. 561 (Differential Geometry), Math.
(Projective Geometry), Math. 565 (Con-
Figures and Inequalities).

ast one of the following one-year
ences:
1. 521-522 (Advanced Calculus),
1. 541-542 (Modern Algebra).

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and 551. They should also acquire
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ges as early as possible. For mathe-
cs the important languages are Rus-
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e School of Education who major in
ematics must earn a 2.5 grade-point
age in their advanced mathematics
ses and meet these requirements:

years of high school mathematics
satisfactory placement scores or
1. 112 and 113 (Algebra and Trigonom-

the following or an equivalent
ence 221, 222, 223 (Cal. and Analytic
netry)

and c
41-542 (Modern Algebra)
hoice of
College Geometry I) or
Convex Figures and Inequalities)
ectives (9 credits) chosen from:
nore than one course from Math. 240
oductory Finite Mathematics), Math.
Topics in College Math.), Math. 320
ar Mathematics), or announced
valent; any mathematics course num-

bered above 302; not more than one Computer Science course numbered 301 and above.

4. Education courses:
Professional education courses
Curric. 163 (Teaching of Mathematics), 2 credits. Consult the *School of Education Bulletin* for further details.

Mathematics Honors Courses

Honors credit is offered in the honors sections of Mathematics 221, 222, 223, 320.

L&S General Honors Program

To earn the B.A. or B.S. with honors, majors in mathematics must complete (a) the L&S general course degree requirements, (b) the General Honors Program requirements, and (c) the junior-senior honors curriculum in the department.

Junior-senior honors curriculum. Honors majors must complete the honors courses 521-522 and 541-542, together with at least a one-semester honors course In geometry or topology. They must in the senior year take 681-682 (Senior Honors Thesis). Alternatives to the Senior Thesis are sometimes available. Details should be obtained from the department honors adviser during the student's junior year. Honors credit will be offered in the following advanced courses: 419, 431, 521, 522, 541, 542, 551, 552, 561, 563, 565, 567, 568, 623, 632, 629. In addition, any graduate course taken by an undergraduate will carry honors credit.

Honors in the Major

Students majoring in mathematics who are not honors candidates may earn honors in the major by satisfactorily completing the junior-senior honors program in mathematics described above.

600 (CURRICULAR AREA NUMBER)

Elementary Courses

The courses 221, 222, 223 form a three-semester sequence in calculus and analytic geometry for students of mathematics, science, and engineering. The courses 211, 212 form a two-semester sequence in calculus and related topics, a terminal course.

099 Algebra. I; 2 cr. Review of fractions and signed numbers and roughly the first half of Math. 101. Prereq: Minimum mathematical competence (one unit each of high school algebra and geometry) and suitable placement scores. For students with mastery of fundamental arithmetic skills, but without the competence in algebra necessary for Math. 101. Math. 99 and Math. 100 together amount to one unit for the L&S mathematics requirement.

100 Algebra. II; 2 cr. Prereq: Math. 99. Continuation of Math. 99. The sequence Math. 99-Math. 100 covers the material of Math. 101.

101 Intermediate Algebra. I, II; 4 cr. The equivalent of intermediate mathematical competence (Level 2, as defined above). Prereq: Minimum mathematical competence (one unit each of high school algebra and geometry) and satisfactory placement scores.

107 Introductory Mathematics of Finance and Probability. I, II; 4 cr. Mathematical characteristics of currently used financial growth laws, annuities, amortization, sinking funds, and bonds, the algebra of sets, elementary logic and probability, Bayes theorem, independence of events. Prereq: Advanced mathematical competence-Algebra, and satisfactory placement scores (or Math. 112).

110 Elementary Statistical Analysis. (See Stat. 110.) I, II; 3 cr.

112 Algebra. I, II; 3 cr. The equivalent of advanced mathematical competence-Algebra (Level 3a, as defined above). Not normally open to students with 4 or more semesters of high school algebra. Prereq: Intermediate mathematical competence (usually three units of high school mathematics) and satisfactory placement scores, or Math. 101.

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113 Trigonometry. I, II; 2 cr. The equivalent of advanced mathematical competence-Trigonometry (Level 3b, as defined above). Not normally open to students with one or more semesters of trigonometry. Prereq: (i) Intermediate mathematical competence and satisfactory placement scores, or Math. 101; and (ii) Advanced mathematical competence-Algebra and satisfactory placement scores, or completion of or con reg in Math. 112.

114 Algebra and Trigonometry. I, II; 5 cr. Covers in a single course the material of Math. 112 and Math. 113. Prereq: Intermediate mathematical competence (usually three years of high school mathematics) and satisfactory placement scores, or Math. 101. Students may not receive credit for both Math. 112 and 114, nor for both Math. 113 and 114.

211 Calculus and Related Topics. I, II; 4 cr. Primarily for students in L&S who wish to acquire some knowledge of the development of mathematics and its use in the modern world. Topics: the essential concepts of differential and integral calculus and perhaps other topics such as linear algebra, linear programming and probability. Students preparing for further study in advanced mathematics (e.g., majors in mathematics, physics, etc.) should take the sequence Math. 221-222, 223. Prereq: (i) Advanced mathematical competence-Algebra and satisfactory placement scores (or Math. 112); and (ii) Advanced mathematical competence-Trigonometry and satisfactory placement scores or Math. 113.

212 Calculus and Related Topics. I, II; 4 cr. Continuation of 211. Prereq: Math. 211.

221 Calculus and Analytic Geometry. I, II; 5 cr. (Calculus for students of mathematics, science, and engineering) Introduction to differential and integral calculus and plane analytic geometry; applications; transcendental functions. Prereq: (i) Advanced mathematical competence-Algebra and satisfactory placement scores (or Math. 112); and (ii) Advanced mathematical competence-Trigonometry and satisfactory placement scores (or completion of Math. 113). Completion of Math. 114 satisfies both (ii) and (iii). A student with advanced mathematical competence-Algebra or an A in Math. 112 may take Math. 113 and Math. 221 concurrently.

222 Calculus and Analytic Geometry. I, II; 5 cr. (For students of mathematics, science, and engineering) Topics: techniques of integration, conic sections, polar coordinates, vectors, infinite series. Prereq: (i) Advanced mathematical competence-Trigonometry and satisfactory placement scores or Math. 113; and (ii) Math. 221.

223 Calculus and Analytic Geometry. I, II; 5 cr. (Calculus for students of mathematics, science, and engineering) Introduction to calculus of functions of several variables; multiple integrals; introduction to differential equations. Prereq: Math. 222.

240 Introductory Finite Mathematics. I, II; 4 cr. Elements of mathematical logic; sets, partitions, and counting; probability theory; stochastic processes. Prereq: Advanced mathematical competence-Algebra and satisfactory placement scores or Math. 112.

251 Topics in College Mathematics. I, II; 4 cr. A development in depth of several problems from concrete examples to a mathematical theory. Emphasis on both the method of abstraction and the theory itself. Prereq: Advanced mathematical competence-Algebra and satisfactory placement scores or Math. 112.

252 Topics in College Mathematics. I, II; 4 cr. Continuation of Math. 251. The year course 251-252 fulfills the L&S requirement of a year of calculus or equivalent. The student should note, however, that some departments explicitly require calculus. Prereq: Math. 251.

301 Calculus. I; 5 cr. Functions, limits; derivatives, applications of the derivative; indefinite and definite integrals and applications; transcendental functions; techniques of integration. Prereq: Advanced mathematical competence and a course in analytic geometry.

302 Calculus. II; 5 cr. Partial derivatives, multiple integrals, infinite sequences and series; introductory differential equations (physical motivation, elementary techniques, series solutions). Year (301-302) gives the student the same mathematical preparation as the 221-222-223 sequence. Prereq: Math. 301.

303 Theory of Life Insurance. I, II; 3 cr. Mathematics of life insurance; mortality tables, net premiums, reserves, nonforfeiture benefits, gross premiums. Prereq: Two courses in mathematics.

309 Introduction to Mathematical Statistic (See Stat. 309.) I; 4 cr.

310 Introduction to Mathematical Statistic (See Stat. 310.) II; 4 cr.

313 Actuarial Mathematics. I; 3 cr. Ordinary differences and related operators, dividend differences; polynomial interpola tion, summation, numerical differentiation osculatory interpolation, approximate inte gration; difference equations. Prereq: Math. 223.

320 Linear Mathematics. I, II; 3 cr. Intro duction to linear algebra, including matrices, linear transformations, and eigenvalues. Linear systems of differenti equations. Numerical aspects of linear problems. Prereq: Math. 223.

321 Applied Mathematical Analysis. I, II 3 cr. Vector analysis: algebra and geom try of vectors, vector differential and inte gral calculus, theorems of Green, Gauss and Stokes; complex analysis: analytic functions, complex integrals and residue Taylor and Laurent series. Prereq: Math 320.

322 Applied Mathematical Analysis. I, I 3 cr. Sturm-Liouville theory; Fourier ser including mean convergence; boundary value problems for linear second order partial differential equations, including separation of variables and eigenfunctio expansions. Prereq: Math. 321.

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ıment scores (or completion of Math. Completion of Math. 114 satisfies (ii) and (iii). A student with advanced ematical competence-Algebra or an A th. 112 may take Math. 113 and Math. oncurrently.

Calculus and Analytic Geometry. I, II; (For students of mathematics, sci- and engineering) Topics: techniques egration, conic sections, polar co- ates, vectors, infinite series. Prereq: vanced mathematical competence- ometry and satisfactory placement or Math. 113; and (ii) Math. 221.

alculus and Analytic Geometry. I, II; Calculus for students of mathemat- ience, and engineering) Introduction ulus of functions of several vari- multiple integrals; introduction to ntial equations. Prereq: Math. 222.

troductory Finite Mathematics. I, II; lements of mathematical logic; sets, ns, and counting; probability theory; stic processes. Prereq: Advanced natical competence-Algebra and tory placement scores or Math. 112.

pics in College Mathematics. I, II; development in depth of several ıs from concrete examples to a atical theory. Emphasis on both the of abstraction and the theory itself. Advanced mathematical compe- lgebra and satisfactory placement or Math. 112.

ics in College Mathematics. I, II; ntinuation of Math. 251. The year 51-252 fulfills the L&S requirement of calculus or equivalent. The should note, however, that some ents explicitly require calculus. Math. 251.

ulus. I; 5 cr. Functions, limits; es, applications of the derivative; and definite integrals and appli- ranscendental functions; tech- integration. Prereq: Advanced tical competence and a course in leometry.

302 Calculus. II; 5 cr. Partial derivatives, multiple integrals, infinite sequences and series; introductory differential equations (physical motivation, elementary techniques, series solutions). Year (301-302) gives the student the same mathematical preparation as the 221-222-223 sequence. Prereq: Math. 301.

303 Theory of Life Insurance. I, II; 3 cr. Mathematics of life insurance; mortality tables, net premiums, reserves, nonforfeiture benefits, gross premiums. Prereq: Two courses in mathematics.

309 Introduction to Mathematical Statistics. (See Stat. 309.) I; 4 cr.

310 Introduction to Mathematical Statistics. (See Stat. 310.) II; 4 cr.

313 Actuarial Mathematics. I; 3 cr. Ordinary differences and related operators, dividend differences; polynomial interpolation, summation, numerical differentiation, osculatory interpolation, approximate integration; difference equations. Prereq: Math. 223.

320 Linear Mathematics. I, II; 3 cr. Introduction to linear algebra, including matrices, linear transformations, and eigenvalues. Linear systems of differential equations. Numerical aspects of linear problems. Prereq: Math. 223.

321 Applied Mathematical Analysis. I, II; 3 cr. Vector analysis: algebra and geometry of vectors, vector differential and integral calculus, theorems of Green, Gauss, and Stokes; complex analysis: analytic functions, complex integrals and residues. Taylor and Laurent series. Prereq: Math. 320.

322 Applied Mathematical Analysis. I, II; 3 cr. Sturm-Liouville theory; Fourier series, including mean convergence; boundary value problems for linear second order partial differential equations, including separation of variables and eigenfunction expansions. Prereq: Math. 321.

342 Survey of the Foundations of Arithmetic. SS only; 3 cr. Lectures for teachers; a critical study of the numbers and operations of elementary arithmetic; rational operations and the fundamental laws, scales of notation, the unique factorization theorem for integers, the rule of casting out nines, the greatest common divisor and least common multiple, the rational fractions, the real numbers, the complex numbers, fractional and negative exponents, and logarithms. Prereq: Cons instr.

343 Survey of the Foundations of Algebra. SS only; 3 cr. Lectures, primarily for teachers, on the fundamental concepts of elementary algebra.

344 Topics in Classical Algebra. SS; 3 cr. Such topics as interpolation, combinatorial analysis, continued fractions, regions in which zeros of polynomials lie, and certain aspects of the theory of determinants. Prereq: Analytic geometry and calculus.

371-372 Basic Concepts of Mathematics. Yr; 3 cr. Foundations of number theory, algebra, geometry, and analysis, with attention to the historical backgrounds and the recent developments of these subjects; of primary interest to teachers in the secondary schools. Prereq: Cons instr.

417 Introduction to Differential Equations. I, II; 3 cr. A first course; elementary methods of solutions, physical applications, power series solutions and other topics. Prereq: Three semesters of calculus without differential equations. Not open to students who have taken Math. 223 at the Madison campus.

419 Intermediate Differential Equations. I, II; 3 cr. Systems of differential equations, stability, qualitative behavior, and physical examples. Prereq: Math. 320.

431 Introduction to the Theory of Probability. (Same as Stat. 431.) I, II; 3 cr. Probability in discrete sample spaces; combinatorial analysis; conditional probabilities, stochastic independence, Laplace limit theorem, Poisson distribution, laws of large numbers, random variables, applications to physics and statistics. Prereq: Math. 223.

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443 Applied Linear Algebra. I, II; 3 cr. Review of matrix algebra. Simultaneous linear equations, linear dependence and rank, vector space, eigenvalues and eigenvectors, diagonalization, quadratic forms, inner product spaces, norms. For students whose main field of interest is not pure mathematics. Discussion of numerical aspects and applications in the sciences. Prereq: Math. 320 or cons instr.

461 College Geometry I. Sem; 3 cr. An introduction to Euclidean geometry at the college level. Prereq: Math. 223.

462 College Geometry II. Sem; 3 cr. Such topics as the foundations of Euclidean and non-Euclidean geometry, isometry and similarity in Euclidean space, algebraic curves, etc. Prereq: Math. 461.

463 Topics in Geometry. SS; 3 cr. To broaden the understanding of high school geometry by discussion of related elementary, but modern, topics; of primary interest to teachers in secondary schools. Prereq: Math. 462 or cons instr.

473 History of Mathematics. Sem; 3 cr. A survey of the main lines of mathematical development from the Babylonians, Egyptians and Greeks to the present day; the lives of great mathematicians: Euclid, Archimedes, Descartes, Newton, Gauss, etc. Prereq: Cons instr.

475 Introduction to Combinatorics. 3 cr. Problems of enumeration, distribution, and arrangement. Inclusion-exclusion principle. Generating functions and linear recurrence relations. Combinatorial identities. Graph coloring problems. Finite designs. Systems of distinct representatives and matching problems in graphs. Potential applications in the social, biological, and physical sciences. Puzzles. Emphasis on problem solving. Prereq: Math. 212 or 222 and cons instr.

490 Undergraduate Seminar. Sem; 1-3 cr. Student presentation of selected classical topics not usually treated in standard courses, or results of independent research. Primarily for mathematics majors. Prereq: So st and cons instr.

513-514 Introduction to Numerical Analysis. (See Comp. Sci. 513-514.) Yr; 3 cr per sem.

521 Advanced Calculus. I, II; 3 cr. Fundamental notions of limits, continuity, differentiation, and integration, for functions of one or more variables, convergence and uniform convergence of infinite series, and improper integrals. Prereq: Math. 223.

522 Advanced Calculus. I, II; 3 cr. Differentials and Jacobians, transformation of coordinates and of multiple integrals, line and surface integrals. Prereq: Math. 521.

525 Linear Programming Methods. (See Comp. Sci. 525.) I; 3 cr.

541 Modern Algebra. I, II; 3 cr. Groups, normal subgroups, Cayley's theorem, rings, ideals, homomorphisms, polynomial rings, abstract vector spaces. Prereq: Math. 320 or cons instr.

542 Modern Algebra. I, II; 3 cr. Field extensions, roots of polynomials, splitting fields, simple extensions, linear transformations, matrices, characteristic roots, cononical forms, determinants. Prereq: Math. 541.

551 Elementary Topology. I, II; 3 cr. Topological spaces, connectedness, compactness, separation axioms, metric spaces. Prereq: Math. 223.

552 Elementary Geometric and Algebraic Topology. Sem; 3 cr. Introduction to algebraic topology. Emphasis on geometric aspects, including two-dimensional manifolds, the fundamental group, covering spaces, basic simplicial homology theory, the Euler-Poincare formula, and homotopy classes of mappings. Prereq: Math. 551 and Math. 542.

561 Differential Geometry. II; 3 cr. Theory of curves and surfaces by differential methods. Prereq: Math. 320 and 521.

563 Projective Geometry. Sem; 3 cr. Analytic and synthetic projective geometry; finite planes, non-Desarquesian planes, and the algebraic structures associated with them. Prereq: Math. 320.

565 Convex Figures and Inequalities. Sem; 3 cr. Simplest geometrical properties of convex figures and their applications to the fundamental inequalities in use in every mathematical analysis. Prereq: Math. 32

567 Elementary Number Theory. Sem; 3 cr. Fundamental theorem of arithmetic quadratic residues and quadratic reciprocity, number-theoretic functions, certain diophantine equations, Farey fractions, continued fractions. Prereq: Math. 223.

568 Elementary Number Theory. Sem; 3 Elementary prime number theory, Minkowski's theorem, Gaussian integers, unique factorization in quadratic fields, high-residues, irrational numbers, approximation by rational numbers. Prere Math. 567.

571 Mathematical Logic. I, II; 3 cr. Validity and formal proofs in propositio and predicate calculus, computability a decidability, Church's Theorem, Godel's Incompleteness and Completeness Theorems. Prereq: Jr st and cons instr

615-616 Introduction to Applied Mathematics and Numerical Analysis. Yr; 3 c The mathematical formulation of physic problems; exact and approximate meth for solving the resulting equations. Pre Math. 521.

623 Complex Analysis. I; 3 cr. Elemer functions of a complex variable; confo mapping; complex integrals; the calcul of residues. Prereq: Math. 321 or 521.

629 Introduction to Measure and Integ tion. II; 3 cr. Lebesgue integral and m ure, abstract measure and integration, differentiation, spaces of integrable fu tions. Prereq: Math. 552.

632 Introduction to the Theory of Prob ity. (Same as Stat. 632.) I, II; 3 cr. Ra dom walks, renewal theory, Markov processes, branching processes. App tions to physics, biology, and enginee Prereq: Math. 431.

681-682 Senior Honors Thesis. *cr. Prereq: Sr st and enrollment in the Ho Program.

699 Directed Study. I, II; *cr.

For graduate courses and programs, Graduate bulletins, *Natural Sciences*

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anced Calculus. I, II; 3 cr. Funda- notions of limits, continuity, differ- l, and integration, for functions of nore variables, convergence and convergence of infinite series, and r integrals. Prereq: Math. 223.

anced Calculus. I, II; 3 cr. Differ- and Jacobians, transformation of ates and of multiple integrals, line face integrals. Prereq: Math. 521.

ear Programming Methods. (See Sci. 525.) I; 3 cr.

dern Algebra. I, II; 3 cr. Groups, subgroups, Cayley's theorem, rings, homomorphisms, polynomial rings, t vector spaces. Prereq: Math. 320 instr.

dern Algebra. I, II; 3 cr. Field ex- s, roots of polynomials, splitting simple extensions, linear transforma- natrices, characteristic roots, cal forms, determinants. Prereq: 341.

ementary Topology. I, II; 3 cr. Topo- spaces, connectedness, compact- eparation axioms, metric spaces. : Math. 223.

ementary Geometric and Algebraic gy. Sem; 3 cr. Introduction to aic topology. Emphasis on geometric s, including two-dimensional mani- he fundamental group, covering s, basic simplicial homology theory, ler-Poincare formula, and homotopy s of mappings. Prereq: Math. 551 ath. 542.

ifferential Geometry. II; 3 cr. Theory ves and surfaces by differential meth- Prereq: Math. 320 and 521.

rojective Geometry. Sem; 3 cr. Ana- nd synthetic projective geometry; planes, non-Desarquesian planes, and gebraic structures associated with Prereq: Math. 320.

onvex Figures and Inequalities. Sem; Simplest geometrical properties of x figures and their applications to the fundamental inequalities in use in everyday mathematical analysis. Prereq: Math. 320.

567 Elementary Number Theory. Sem; 3 cr. Fundamental theorem of arithmetic, quadratic residues and quadratic reciprocity, number-theoretic functions, certain diophantine equations, Farey fractions, continued fractions. Prereq: Math. 223.

568 Elementary Number Theory. Sem; 3 cr. Elementary prime number theory, Minkowski's theorem, Gaussian integers, unique factorization in quadratic fields, high-residues, irrational numbers, approximation by rational numbers. Prereq: Math. 567.

571 Mathematical Logic. I, II; 3 cr. Validity and formal proofs in propositional and predicate calculus, computability and decidability, Church's Theorem, Godel's Incompleteness and Completeness Theorems. Prereq: Jr st and cons instr.

615-616 Introduction to Applied Mathematics and Numerical Analysis. Yr; 3 cr. The mathematical formulation of physical problems; exact and approximate methods for solving the resulting equations. Prereq: Math. 521.

623 Complex Analysis. I; 3 cr. Elementary functions of a complex variable; conformal mapping; complex integrals; the calculus of residues. Prereq: Math. 321 or 521.

629 Introduction to Measure and Integration. II; 3 cr. Lebesgue integral and measure, abstract measure and integration, differentiation, spaces of integrable functions. Prereq: Math. 552.

632 Introduction to the Theory of Probability. (Same as Stat. 632.) I, II; 3 cr. Random walks, renewal theory, Markov processes, branching processes. Applications to physics, biology, and engineering. Prereq: Math. 431.

681-682 Senior Honors Thesis. *cr. Prereq: Sr st and enrollment in the Honors Program.

699 Directed Study. I, II; *cr.

For graduate courses and programs, see Graduate bulletins, *Natural Sciences and Engineering* or *Social Sciences and Humanities.*

MEDICAL MICROBIOLOGY

Courses in the Department of Medical Microbiology and the Department of Bacteriology are accepted as regular letters and science courses. Students who wish preparation for positions in the field of bacteriology may take the major either in the Department of Medical Microbiology or in the Department of Bacteriology. Depending upon the department selected the student should consult the undergraduate adviser of medical microbiology or the chairman of bacteriology.

Requirements for the Major

1. Completion of requirements for B.A. or B.S. degree
2. The following course sequence should not be departed from without consulting adviser. A minimum of 24 major credits (designated by an *), including the following:

First year:
2 semesters of general chemistry
1 semester of beginning zoology

Second year:
1 semester of quantitative analysis (Chem. 221)
1 semester of organic chemistry including lab (341 & 344)
General Bacteriology 101*
Animal Parasites 350*

Third year:
Physiological Chemistry 603* Including lab
(Option: Biochemistry 501 & 651)
Advanced General Bacteriology 320* (Option: Medical Microbiology 365 **or** Preventive Medicine 603)

Fourth year:
Medical Microbiology 301*
Bacteriology 328*
Bacteriology 329*

3. One year of physics recommended
4. Competence in English—satisfied by essay

If the student considers the possibility of continuing for the Ph.D. degree, several other courses should be taken, preferably at the undergraduate level: General physics (2 semesters), comparative anatomy, comparative or human histology, general