College of Letters and Science

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1984

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Contents

The information, policies, and rules contained herein may be changed without notice. No part of this bulletin should be construed as a contract or offer to contract. The bulletin is intended only as an informational guide to the University of Wisconsin-Madison College of Letters and Science.

Students should bring this bulletin to registration. Additional copies may not be available at that time.

275 German Classics in Translation. Sem; 3 cr (L-I). P: So st or cons inst.

276 German Masterpieces in Translation. Sem; 3 cr (L-E). Open to Fr.

277 Trends in Modern German Literature. Sem; 3 cr (L-I). Reading and discussion of developments in modern German literature from Brecht, Hesse, Kafka, Mann to contemporary authors such as Boll, Durrenmatt, Grass, Weiss. Open to freshmen. Not open to students who have taken or are taking German 302 or above.

279 Yiddish Literature in Translation. Sem; 3 cr (L-I). P: So st or cons inst.

Hebrew

361 Hebrew Literature (in translation)—Biblical Period and Post-Biblical Period. I, 3 cr (L-I). Introduction to the literature and literary history of the Old Testament, Apocrypha, Dead Sea Scrolls, Talmud, and Midrashim. All readings in English. P: So st or cons inst.

362 Hebrew Literature (in translation)—Post-Biblical Period. II, 3 cr (L-I). Secular Hebrew poetry and fiction from the medieval period through contemporary Israeli works. Great poets, novelists, and short story writers of the Hebrew language. All readings in English. P: So st.

363 Israeli Fiction (in English). Sem; 3 cr (L-I). Major writers, trends and themes in Israeli fiction from pre-State period to present.

Italian

253 Dante's *Divine Comedy.* I; 3 cr (L-I). Rodini.

254 The Literature of Modern Italy: Existentialism, Facism, Resistance II. 3 cr (L-I). Aragno.

255 Boccaccio's *Decameron:* the Human Comedy. I; 3 cr (L-I). Rossi.

460 Special Topics in Italian Literature. Sem; 3-4 cr (I). Treatment of a specific period, genre, theme, or movement in Italian literature. P: So st.

Scandinavian

273-274 Masterpieces of Scandinavian Literature. (Concurrent with Scand 373-374) Yr; 2-3 cr (L-E). Open to Fr.

275 The Tales of Hans Christian Anderson. (Concurrent with Scand 375) Sem; 2-3 cr (L-E). Open to Fr. Ingwersen.

335 The Drama of Henrik Ibsen. (Concurrent with Scand 422) Sem; 2-3 cr (L-A). Naess.

336 The Drama of August Strindberg. (Concurrent with Scand 423) Sem; 2 or 3 cr (L-A). Vowles.

337 Nineteenth Century Scandinavian Fiction. (Concurrent with Scand 424) Sem; 2 or 3 cr (L-A). Ingwersen.

338 Knut Hamsun and Twentieth Century Norwegian Novel. (Concurrent with Scand 425) Sem; 2 or 3 cr (L-A). Naess.

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

340 Contemporary Scandinavian Literatures. (Concurrent with Scand 427) Sem; 2 or 3 cr (L-A). Vowles.

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

342 Mythology of Scandinavia. (Concurrent with Scand 429) Sem; 3 cr (L-A). Ringler, Ingwersen, Naess.

343 The Woman in Scandinavian Literature. (Concurrent with Scand 420) Sem; 3 cr (L-A). Clareus.

344 Kalevala and Finnish Folklore. (Concurrent with Scand 444.) Sem; 2 or 3 cr (L-A). Nilsson.

345 The Scandinavian Tale and Ballad. (Concurrent with Scand 433) Sem; 2-3 cr (L-I). Ingwersen.

346 The Icelandic Sagas. (Concurrent with Scand 435.) Sem; 2-3 cr (L-A). Naess.

Slavic

201 Survey of Nineteenth and Twentieth Century Russian Literature. I; 3 cr (L-E). Pushkin to Tolstoy; reading and lecture in English. Open to Fr.

202 Survey of Nineteenth and Twentieth Century Russian Literature. II; 3 cr (L-E). Dostoevsky to the present, reading and lecture in English. Open to Fr. Rosenshield.

205 The Woman in Russian Literature. Sem; 3 cr (L-A). P: So st.

220 Chekhov. Sem; 3 cr (L-A). P: So st. Rosenshield.

221 Gogol. Sem; 3 cr (L-A). P: So st. Bailey.

222 Dostoevsky. II; 3 cr (L-A). Major works, lecture in English. P: So st. Rosenshield, Shaw.

224 Tolstoy. Sem; 3 cr (L-A). Major works, lecture in English. P: So st. Shaw.

240 Soviet Literature. Sem; 3 cr (L-A). Lecture in English. P: So st. Bethea.

256 Masterpieces of Russian Drama. I; 3 cr (L-A). Main Russian dramatists and plays from the end of the eighteenth century to the present. P: So st. Bailey, Filipowicz.

258 Trends in Russian Literary Criticism: The Age of Pushkin to Today. Sem; 3 cr (H-A). **Not a literature course.** P: So st. Shaw.

259 Masterpieces of Polish Literature. Sem; 3 cr (L-A). Their literary importance and social significance; lecture in English. P: So st. Filipowicz.

415 Russian Folklore. Sem; 3 cr (L-A). Main genres of Russian folklore, agricultural calendar, folk beliefs, and history of Russian folkloristics; works in English translation; lectures in English. P: Jr st and 6 cr literature. Bailey.

South Asian

272 Modern Indian Literature in Translation. Sem; 3 cr (L-I). Critical and comparative study of literary works in Modern Indian Languages, with special emphasis on Bankim Chandra Chatterjee in Bengali, Prem Chand in Hindi, Ghalib in Urdu, and other significant writers whose books are available in English translation. Nilsson.

346 Literatures of India: From Bhagavad Gita to Tagore. Sem; 3 cr (L-I). An exploration of significant religious and secular writing in ancient and modern Indian languages, e.g. Sanskrit, Old Tamil, Medieval Hindi, Urdu, Malayan and Bengali, mainly in the genre of drama and poetry. Nilsson.

361 Persian and Urdu Literatures in Translation. Sem; 3 cr (L-I). An introductory survey of Persian and Urdu literatures shaped essentially within areas of Muslim influence (Iran, India, Pakistan). Emphasis on the interrelationship of these literatures, their common repertoire of literary conventions, themes, motifs, genres, and images, with readings in a few representative works of prose and poetry, essentially in translation. Offered once a year (preferably in the fall). Open to Fr. Memon.

377 Modern Indonesian Literature in Translation. Sem; 3 cr (L-I). Selected representative novels, short stories, letters, and verse, almost all from the twentieth century. Collateral historical, critical, and biographical readings. Freshmen admitted only with cons inst. Rafferty.

Spanish

243 Cervantes' *Don Quixote.* Sem; 3 cr (L-A). Life and the works of Cervantes; historical developments in sixteenth and seventeenth century Spain relating to literature; influence of Cervantes in foreign literature. P: Open to all undergraduates.

255 Spanish and Portuguese Masterpieces in Translation. Sem; 3 cr (L-A). Major works of fiction, drama and poetry.

256 Miguel de Unamuno: Literature in Translation. I; 1 cr (L-D). The life and philosophy of Unamuno and his significance in Hispanic literature. Emphasis on his theory of the novel through a close study of three key texts. Texts and papers in English.

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

267 Jorge Luis Borges: Literature in Translation. I; 1 cr (L-D). The life of Borges and development of his major philosophic and esthetic ideas studied through key texts. Texts and papers in English.

MATHEMATICS

213 Van Vleck Hall, 263-3053

Professors Ahern, Askey, Barwise, Bauman, Beck, Benkart, Bicknell, Bleicher, Box, Brauer, Brualdi, Bruck, Buck, Cannon, Chover, Conley, Conner, Crandall, Crowe, deBoor, Dickey, Fadell, Forelli, Griffeath, Gunji, Hall, Harvey, Hellerstein, Husseini, Isaacs, A. Johnson, M. Johnson, Keisler, Kuelbs, Kunen, Kurtz, Levin, Levy, McMillan, Meyer, Miles, Moore, Nagel, Ney, Noble, Nohel, Orlik, Osborn, Parter, Passman, Rabinowitz, Rall, Rider, Robbin, Rothschild, M. Rudin, W. Rudin, Russell, Schneider, Shea, Shen, Smart, Solomon, Turner, Uhlenbrock, Voichick, Wainger; Associate Professor Millar; Assistant Professors Broughton, Fernandez, Glynn, Hershkowitz, Jackson, Manber, Pence, Renardy, Stredulinsky, Strikwerda, van Douwen, Vanden-Broeck, Wilson, Zacharia.

Undergraduate adviser (academic year only): Prof. M. Voichick, 405 Van Vleck, 262-3221

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 mathematics for techniques needed to explore the consequences of scientific theories. In the last few decades social scientists have increasingly found higher mathematics of value in their training and research.

Opportunities for academic positions for mathematics Ph.D.'s and opportunities for undergraduate math majors appear to be good. Recruiters from various types of companies and governmental agencies continue to offer interviews to undergraduate math majors on this campus and there continue to be openings for qualified candidates for teaching at the secondary school level. (Such positions normally require teacher certification.) Also various departments in fields which use mathematics, including some in the social and life sciences as well as the physical sciences, are interested in attracting math majors into their programs. The math major requirements are flexible enough to allow preparation for various 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 program, the School of Business in Actuarial Science, and the School of Education.

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 Math 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 through the UW-Extension or by 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

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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, number theory, calculus, or topics in modern algebra are suitable for high school students of superior ability.

Advanced Placement Credit. A student who has completed a substantial calculus course in high school may earn university degree credit for Math 221 or for 221 and 222 by one of the following: (1) the College Board calculus advanced placement exam; (2) the Math Department calculus advanced placement exam; or (3) advanced placement tests given in conjunction with calculus courses at certain Wisconsin high schools.

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 a 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.

Expected Levels and Courses. A student with only one unit of algebra and one unit of geometry in high school would normally achieve minimum competence and be placed in Math 101. A student with three years of high school mathematics would normally achieve intermediate competence and be placed in Math 112 or 114. A student with four years of high school mathematics would normally achieve advanced competence and be placed in Math 211 or 221.

Departmental Policy Regarding a *D* Grade. A student should repeat a Math course in which a grade of *D* is earned and which serves as a prerequisite to another course to be elected. A *D* grade commonly signifies some achievement but usually denotes a weak foundation upon which to build subsequent course work.

Audit

Normally students are not permitted to audit elementary and intermediate level math courses. Students are permitted to audit advanced math courses.

Major

A detailed description of the mathematics major program is in the *Guidebook for Undergraduate Math Majors* available in Van Vleck Hall.

Acceptance. To be accepted as a major in mathematics a student must complete Math 221, 222, and 223 (or equivalent sequence) with a grade-point average of 2.5 or better in this sequence. However, a somewhat higher grade-point average is advisable. Soon after completing Math 223 math majors should have their math advisers complete the Major Declaration Form and, perhaps later, but by the beginning of the senior year, the Math Major Approval Form. The former indicates acceptance into the major and the latter specifies which major requirements the student will satisfy. Majors are assigned math advisers through the Advising Secretary in 307 Van Vleck Hall.

Major Requirements: Non-Honors

The student chooses one of two options. Since both options allow considerable flexibility, students should plan their programs with the advice of their math advisers. Indeed, those following Option II must have their programs formally approved by their mathematics advisers. While Option II emphasizes the applications of mathematics, those following Option I are also encouraged to take courses in other departments which involve the application of mathematics.

Option I: Six mathematics courses numbered above 306, excluding 490. These six courses must include (1) 320 or 340, and (2) three courses numbered above 500 including at least two of the following: 521, 541, 551.

It is recommended that students select at least one course from a miniumum of two of the following groups:

a) 461, 552, 561, 565
b) 321, 522, 623, 629
c) 319, 322, 419
d) 309, 310, 431, 632
e) 443, 542, 567
f) 571
g) 475
h) 513, 514, 525

Recommendations: Students preparing for graduate work in mathematics should satisfy a, b, and c below.

a) 340, 521, 522, 541, 542
b) 551 or 561
c) At least one course from a minimum of two of the following groups:
   i) 623, 629
   ii) 570
   iii) 322, 419
   iv) 309, 310, 431, 632
   v) 567
   vi) 475
   vii) 513, 514, 525

Students who plan to enter a mathematics Ph.D. program should acquire a **reading knowledge of two foreign languages** as early as possible. For mathematics the important languages are French, German, Russian and, possibly, Italian.

Option II: (for students interested in a particular area of application)

a) Four courses in some area of application of mathematics, including at least three courses at the intermediate or advanced level, selected with the approval of the student's mathematics adviser. Note: Because of the L & S 80 credit rule, if too many of the credits used to satisfy this requirement are from courses in the Mathematics Department or cross-listed with the Mathematics Department, the student will need more than 120 credits to graduate.

AND

b) Six mathematics courses numbered above 306, excluding 490, selected with the approval of the student's mathematics adviser, including 320 or 340 and two courses numbered above 500.

No courses may be used to fulfill both a) and b).

Approval of a program under Option II will be required before a significant part of the program is completed and changes in the approved program will require prior consent of the mathematics adviser. The program is formally approved on the Math Major Approval Form, a copy of which is sent to the Degree Summary Office.

Sample programs for Option II are in the *Guidebook for Undergraduate Math Majors.* The areas of application in these sample programs include: computer sciences, chemistry, physics, statistics, actuarial mathematics, meteorology, ecology, genetics, forestry, business, and engineering.

In some cases the courses suggested in the sample program are close to satisfying the major requirements in the area of application.

Major Requirements: Honors

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

Mathematics Honors Curriculum. Honors majors must successfully complete with grades of *B* or better Math 340H (or 340 credit by examination), 521H, 522H, 541H, 542H, or their equivalents, together with 551 or 4 credits of 490. They must also complete with grades of *B* or better six credits of Math 681-682 (Senior Honors Thesis) or the following: one credit of Math 490 and six

credits in 623, 629, 632, 641 or math courses numbered 700 or above.

Certification of Competence in Expository English. A math major should request certification through the Advising Secretary in Van Vleck Hall at the beginning of the student's senior year. The Mathematics Department will then issue such certification at that time unless the student has been identified by an instructor as being deficient in the use of English. In the case of such a report, the Chairman of the Mathematics Department will appoint a committee of two to prescribe a course of action.

Fifteen-Credit Rule. Mathematics courses numbered above 306 taken in residence count toward this requirement.

Teacher Preparation. Students interested in teaching mathematics at the primary or secondary level should consult the *School of Education Bulletin.*

Honors Courses

It is expected that there will be honors sections of Math 222 and 223 every semester and honors sections in Math 221 every first semester. Honors sections in advanced mathematics courses normally will be offered in the following rotation: Sem I: 340H, 521H, 541H; Sem II: 340H, 522H, 542H. Math 681 and 682 are taken for honors credit. In addition, students may enroll for honors credit in 490, 551, 552, 623, 629 and 632 (listed as "Course recommended for Honors" in the *Timetable.* Other 400, 500 and 600 level mathematics courses may occasionally be listed as "Honors credit available" in the *Timetable.* A graduate course will carry honors credit.

Admission to Honors Courses. In order to be admitted to an honors section or enroll for honors credit a student must have a 3.5 average in previous mathematics courses numbered 221 and above. A student is not required to be in the Honors Program nor an honors major in order to enroll in an honors section except for Math 681 and 682 which are limited to students in the Honors Program.

William Lowell Putnam Competition. This is an annual international mathematics competition for undergraduates, based on originality and cleverness rather than sophisticated mathematical knowledge. Students interested in preparation for this examination may enroll for credit in Math 490 Undergraduate Seminar in the fall semester, or may attend informally. The instructor selects a team to represent UW-Madison, and others may be entered as individuals by the instructor.

Elementary Courses

099 Algebra. I; 2 cr (E). Review of fractions and signed numbers and some Math 101 material. P: 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 100 together amount to one unit for the L & S mathematics requirement. Students may not receive credit for both 99 and 101.

100 Algebra. II; 2 cr (E). Continuation of Math 99. The sequence Math 99-100 covers the material of Math 101. P: Math 99. Students may not receive credit for both 100 and 101.

101 Intermediate Algebra. I, II; 4 cr (E). Polynomial products and factoring, algebraic fractions, linear and fractional equations and inequalities, systems of linear equations, rational and real exponents, radicals, quadratic equations, logarithms, parabolas. P: Minimum mathematical competence (one unit each of high school algebra and geometry) and satisfactory placement scores. Students may not receive credit for both 99 and 101 or for both 100 and 101.

112 Algebra. I, II; 3 cr (E). Polynomial equations, remainder and factor theorems, functions, graphs of functions, simultaneous linear equations, logarithm and exponential functions, sequences and series, mathematical induction, binomial theorem. P: Intermediate mathematical competence (usually three units of high school mathematics) and satisfactory placement scores, or Math 99-100 or 101. Students may not receive credit for both 112 and 114.

113 Trigonometry. I, II; 2 cr (E). Graphs, properties, and geometric significance of trigonometric functions of a real variable, trigonometric equations and identities, applications, trigonometric form of complex numbers, DeMoivre's theorem. P: Advanced mathematical competence—algebra and satisfactory placement scores, or completion of Math 112. Students may not receive credit for both 113 and 114.

114 Algebra and Trigonometry. I, II; 5 cr (E). Covers Math 112 and 113. P: Intermediate mathematical competence (usually three years of high school mathematics) and satisfactory placement scores, or Math 99-100 or 101. Not recommended for a student with less than an *AB* in 100 or 101. Students may not receive credit for both 112 and 114, nor for both 113 and 114.

Courses 120, 121, 122, and 123 are designed for future teachers, and are open only to students in the School of Education, the School of Family Resources and Consumer Sciences, and the classifications PBH, PRE, and PRS. **They may not be used for satisfaction of degree requirements in the College of Letters and Science.**

120 Theory of Arithmetic. I, II; 2 cr. The mathematical systems and operations associated with the arithmetic of integers, rational numbers, real numbers and decimals. Irrationalities and algorithms. Emphasis on a conceptual understanding useful for teaching in the elementary classroom. P: One unit each of algebra and geometry. **Does not count for L & S credit.**

121 Introductory Number Theory. Sem; 1 cr. Properties of integers such as divisibility tests, congruences, casting out of 9's and 11's, magic squares, figurate numbers, and the solution of linear diophantine equations. Normally offered during the last five weeks of the semester. P: One unit each of algebra and geometry. **Does not count for L & S credit.**

122 Real Numbers and Informal Geometry. I, II; 2 cr. Geometric construction of rational and real numbers; of angles, polygons, and other figures. Applications of similarity, area, volume. Emphasis on conceptual understanding useful for teaching in the elementary classroom. P: Math 120. **Does not count for L & S credit.**

123 Intuitive Algebra and Geometry. Sem; 1 cr. A collection of interesting geometrical and topological ideas: mobius bands, Konigsberg bridge problem, graphs, tilings, regular polyhedra, symmetries of geometrical figures. Normally offered during the last five weeks of the semester. P: Math 122. **Does not count for L & S credit.**

Intermediate and Advanced Courses

Calculus Sequences. The Math 221-222 sequence is the first two semesters of the standard three semester calculus sequence, 221-222-223, normally required for all higher level math courses, and should be taken by those preparing for major study in mathematics, the physical sciences, computer sciences, or engineering. It is also recommended for students in the social and life sciences who may want a more substantial introduction to calculus than offered in Math 211-212. The Math 211-212 sequence does not prepare the student for any higher level mathematics courses and does not provide adequate math background for some courses in related fields. It is primarily for pre-business students who will not take more mathematics. Transferring from the 211-212 sequence into the 221-222-223 sequence is usually quite awkward. Transfer students and graduate students with three semesters of calculus which did not include an introduction to differential equations should consider Math 305 which provides the differential equations part of Math 223.

211 Calculus and Related Topics. I, II; 5 cr (N-I). Essential concepts of differential and integral calculus. Primarily for prebusiness students. Students preparing for further study in mathematics should take the Math 221-222 sequence rather than 211-212. P: (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; or 114.

212 Calculus and Related Topics. I, II; 3 cr (N-I). Differential equations, infinite series, math of finance, matrices, linear programming. P: Math 211.

221 Calculus and Analytic Geometry. I, II; 5 cr (N-I). Introduction to differential and integral calculus and plane analytic geometry; applications; transcendental functions. P: (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; or 114.

222 Calculus and Analytic Geometry. I, II; 5 cr (N-I). Techniques of integration, conic sections, polar coordinates, vectors, two and three dimensional analytical geometry, infinite series. P: Math 221.

223 Calculus and Analytic Geometry. I, II; 5 cr (N-I). Introduction to calculus of functions of several variables; multiple integrals; introduction to differential equations. P: Math 222.

240 Elementary Discrete Mathematics. I, II; 3 cr (N-I). Basic concepts of logic and sets, inductive definitions and proofs, binary relations, elementary graph theory, partial orders, equivalence relations, partitions, functions, recursive and iterative algorithms, elementary counting techniques. P: Math 221.

303 Theory of Life Insurance. I, II; 3 cr (N-I). Mathematics of life insurance; mortality tables, net premiums, reserves, nonforfeiture benefits, gross premiums. P: Sem calculus.

305 Brief Introduction to Differential Equations. I; 2 cr (N-I). Primarily for transfer students and graduate students who have had three semesters of calculus without an introduction to differential equations. Equivalent to the differential equations part of Math 223. First and second order differential equations with physical examples; linear differential equations; applications. P: Three semesters of calculus without differential equations. **Not open to students who have had Math 223 at UW-Madison.**

309 Introduction to Mathematical Statistics. (Also Stat 309.) I; 4 cr (N-A).

310 Introduction to Mathematical Statistics. (Also Stat 310.) II; 4 cr (N-A).

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

319 Techniques in Ordinary Differential Equations. I, II; 3 cr (N-A). Review of linear differential equations; series solution of linear differential equations; boundary value problems; Laplace transforms; possibly numerical methods and two dimensional autonomous systems. P: Math 223.

320 Linear Mathematics. I, II; 3 cr (N-A). Introduction to linear algebra, including matrices, linear transformations, eigenvalues, and eigenvectors. Linear systems of differential equations. Numerical aspects of linear problems. P: Math 223. **Credit cannot be received for both 320 and 340.**

321 Applied Mathematical Analysis. I, II; 3 cr (N-A). 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. P: Math 223.

322 Applied Mathematical Analysis. I, II; 3 cr (N-A). 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. P: Math 321.

340 Elementary Matrix and Linear Algebra. I, II; 3 cr (N-A). Matrix algebra, linear systems of equations, vector spaces, sub-spaces, linear dependence, rank of matrices, determinants, linear transformations, eigenvalues and eigenvectors, diagonalization, inner products and orthogonal vectors, symmetric matrices. P: Math 223. **Credit cannot be received for both 320 and 340.**

415 Mathematics for Dynamic Modeling. Sem; 3 cr (N-A). Techniques for formulating models of time dependent phenomena in the social and biological sciences as difference and differential equations. The underlying unity of the formulations emphasized. Topics involving differential equations and linear algebra. P: Math 320 or 340, or other knowledge of matrix algebra.

419 Intermediate Differential Equations. II; 3 cr (N-A). Systems of differential equations, stability, qualitative behavior, and physical examples. P: Math 320 or 340.

431 Introduction to the Theory of Probability. (Also Stat 431.) I, II; 3 cr (N-A). Probability in discrete sample spaces; combinatorial analysis; conditional probabilities, stochastic independence, Laplace limit theorem, Poisson distribution, laws of large numbers, random variables, central limit theorem, applications. P: Math 223.

443 Applied Linear Algebra. I, II; 3 cr (N-A). Review of matrix algebra. Simultaneous linear equations, linear dependence and rank, vector space, eigenvalues and eigenvectors, diagonalization, quadratic forms, inner product spaces, norms, canonical forms. For students whose main field of interest is not pure mathematics. Discussion of numerical aspects and applications in the sciences. P: Math 320 or 340.

461 College Geometry I. I; 3 cr (N-A). An introduction to Euclidean or non-Euclidean geometry at the college level. P: Math 223.

473 History of Mathematics. (Also Hist Sci 473.) Sem; 3 cr (H/N-A). An historical survey of the main lines of mathematical development. P: Calculus.

475 Introduction to Combinatorics. (Also Stat, Comp Sci 475.) II; 3 cr (N-A). 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. Problem solving. P: Math 212 or 222 and cons inst.

490 Undergraduate Seminar. I; 1-3 cr (N-A). Problem solving techniques. P: So st and cons inst.

513-514 Introduction to Numerical Analysis. (Also Comp Sci 513-514.) 3 cr per sem. (N-A)

521 Advanced Calculus. I, II; 3 cr (N-A). 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. P: Math 223. Math 320 or 340 recommended.

522 Advanced Calculus. I, II; 3 cr (N-A). Differentials and Jacobians, transformation of coordinates and of multiple integrals, line and surface integrals. P: Math 521.

525 Linear Programming Methods. (Also Comp Sci, Stat, Ind Engr 525.) 3 cr (N-A).

541 Modern Algebra. I, II; 3 cr (N-A). Groups, normal subgroups, Cayley's theorem, rings, ideals, homomorphisms, polynomial rings, abstract vector spaces. P: Math 320 or 340.

542 Modern Algebra. I, II; 3 cr (N-A). Field extensions, roots of polynomials, splitting fields, simple extensions, linear transformations, matrices, characteristic roots, conical forms, determinants. P: Math 541.

551 Elementary Topology. I, II; 3 cr (N-A). Topological spaces, connectedness, compactness, separation axioms, metric spaces. P: Math 223.

552 Elementary Geometric and Algebraic Topology. Sem; 3 cr (N-A). 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. P: Math 551 and 542.

561 Differential Geometry. Sem; 3 cr (N-A). Theory of curves and surfaces by differential methods. P: Math 320 or 340 and 521.

565 Convex Figures and Inequalities. Sem; 3 cr (N-A). Simplest geometrical properties of convex figures and their applications to the fundamental inequalities in use in everyday mathematical analysis. P: Math 320 or 340.

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

571 Mathematical Logic. (Also Philos 571.) I, II; 3 cr (H/N-A). Basics of logic and mathematical proofs; propositional logic; first order logic; undecidability. P: Math 223.

623 Complex Analysis. I; 3 cr (N-A). Elementary functions of a complex variable; conformal mapping; complex integrals; the calculus of residues. P: 321 or 521.

629 Introduction to Measure and Integration. II; 3 cr (N-A). Lebesgue integral and measure, abstract measure and integration, differentiation, spaces of integrable functions. P: Math 522.

632 Introduction to Stochastic Processes. (Also Bus, Ind Engr, Stat 632.) I, II; 3 cr (N-A). Random walks, renewal theory, Markov processes, branching processes. Applications to physics, biology, and engineering. P: Math 431 or Stat 311 and 312.

633 Queuing Theory and Stochastic Modeling. (Also Ind Engr 633.) 3 cr (N-A). Reliability theory; coherent systems and reliability bounds. Markovian queues and Jackson networks. Steady-state behavior of general service time queues. Priority queues. Approximation methods and algorithms for complex queues. Simulation. Dynamic programming; applications to inventory and queuing. P: Ind Engr 632 or cons inst.

641 Introduction to Error-Correcting Codes. (Also ECE 641.) Sem; 3 cr (N-A). A first course in coding theory. Linear codes: decoding, encoding. Hamming codes: finite fields, BCH codes. Dual codes: weight distribution. Cyclic codes: generator polynomial, check polynomial. Reed-Solomon codes: burst errors. Decoding BCH codes. P: Math 320 or 340, and Math 541 or cons inst.

681-682 Senior Honors Thesis. *cr (N-A). P: Sr st and enrollment in the Honors Program.

699 Directed Study. I, II; *cr (A).

For graduate courses and programs, see the Graduate School bulletin, *Natural Sciences and Engineering.*

MEDICAL MICROBIOLOGY

436 Service Memorial Institutes, 262-3351

Professors Walker (Chairman), Balish, Hong, Schell, Schultz, Smith; Associate Professors Brooks, Hinze, Manning, Proctor; Assistant Professors Byrne, Paulnock, Welch; Lecturer Grover.

Undergraduate adviser: Professor Harry Hinze, 415 SMI, 262-1308

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 microbiology may take the major either in the Department of Medical Microbiology or in the Department of Bacteriology. Prior to declaring the major in Medical Microbiology, students should consult the undergraduate adviser.

Requirements for the Major

1. Completion of requirements for B.A. or B.S. degree.

2. The following courses including a minimum of 38 credits as indicated below are required, and the student should not depart from the sequence without consulting an adviser:

First year
2 semesters of general chemistry
1 semester of beginning zoology including lab

Second year
One semester of quantitative analysis (Chem 221)
One semester of organic chemistry including lab (341 and 344)
Bact 101*
Med Micro 350*
(Option: Zool 353)

Third year
Med Micro 301*
Med Micro 302*
Med Micro 696*
Prev Med 603*
(Option: Bact 320)
Physics 103*
Physics 104*

Fourth year
Med Micro 528*
Med Micro 529*
Phy Chem 603*
Phy Chem 604*

*Required courses for the major: 38 cr.

3. Comp Sci 302 and a course in statistics are strongly recommended.

4. Competence in expository 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: comparative anatomy, comparative or human histology, general genetics, and calculus. For further information see the Graduate School bulletin, *Natural Sciences and Engineering.*

If the student intends to apply to the Medical School, *PreMedicine at Wisconsin* and the *Medical School Bulletin* should be consulted for additional requirements.

301 Pathogenic Microorganisms. I; 3 cr (B-I). Lectures in basic microbiology of pathogenic microorganisms. P: Chem 341 and Bact 101 or 303 or cons inst.

302 Pathogenic Microorganisms Laboratory. I; 3 cr. P: Con reg in Med Micro 301 and cons inst.

350 Animal Parasites of Human Beings. II; 3 cr (B-I). Morphology, life history, diagnosis, and control of the important animal parasites. P: Intro course in Zool.

365 Human Protozoology. SS; 3 cr (B-I). Lab exercises and lectures dealing with the protozoa pathogenic for human beings. P: Intro microbiology or zoology or cons inst.

410 Medical Mycology. II, odd-numbered yrs; 2 cr (B-A). Lectures and discussions: host-parasite relationships, pathogenesis, epidemiology, immunity, and diagnosis of systemic, subcutaneous and superficial mycotic infections. P: A course in general Bact, Med Micro 301 and cons inst.

450 Gastrointestinal Ecology and Anaerobic Microbiology. II, even-numbered yrs); 3 cr (B-A). Consideration of the development, composition, associations, stability, and beneficial and harmful interactions of the microbial flora and its host. Lab: methodology in anaerobic microbiology. P: A course in general Bact, Med Micro 301, 528, and cons inst.

528 Immunology. I; 3 cr (B-A). Development and functions of immune response in animals; a comprehensive study of experimental humoral and cellular immunity. P: Two semesters chemistry and one semester zoology or general biology.

529 Immunology Laboratory. I; 2 cr (B-A). Selected techniques illustrating concepts of cellular and humoral immunity as a supplement to Med Micro 528. P: Two semesters of chemistry and one semester of zoology or general biology. Jr or Sr st; cons inst.

696 Senior Seminar. I; 1 cr (B-A). Lectures on the history, current trends, and research in Medical Microbiology. P: Sr st in Med Micro.

699 Independent Work. I, II; *cr (A) P: Cons inst.

MEDICAL SCIENCE AS AN UNDERGRADUATE MAJOR

It is possible for the exceptional student to be admitted to a medical school at the beginning of the senior year and still earn an undergraduate degree. (Most medical schools, however, prefer to admit students who have already earned a degree.)

Students who wish to attempt to earn a major in Medical Science must satisfy the following requirements: 1) satisfactory completion of at least 90 undergraduate degree credits; 2) at least 30 of the 90 credits must be in residence in the College of Letters and Science, UW-Madison in the semesters just prior to admission to medical school; 3) all L & S General Degree requirements must be satisfied with the exception of a major; and 4) satisfactory completion of the first year of any accredited medical school with advancement to second year medical study.

For further information about the major in Medical Science, inquire at 104 or 307 South Hall.