CATALOGUE

The following bulletins comprise the Catalogue of The University of Texas at Austin:

GENERAL PURPOSE OF THE CATALOGUE

The Catalogue Parts of The University of Texas at Austin are intended to give general information, to record the work of the biennium about to close (except Part V), and to make announcements for the ensuing period specified in each case.

As to the courses to be offered the following Long Sessions, the Catalogue contains only a preliminary announcement and is superseded by the *Course Schedule,* printed each semester.

The Catalogue contains the official regulations. Except as to degree requirements, these regulations are not valid beyond the period specified on the cover page.

Statement on Equal Educational Opportunity

No person shall be excluded from participation in, denied the benefits of, or be subject to discrimination under, any program or activity sponsored or conducted by The University of Texas System or any of its component institutions, on any basis prohibited by applicable law, including, but not limited to, race, color, national origin, religion, sex, or handicap.

COLLEGE OF NATURAL SCIENCES

THE UNIVERSITY OF TEXAS AT AUSTIN

1981–1982 and 1982–1983

With Announcements for 1983–1984 and 1984–1985

Dep't of Math

CATALOGUE NUMBER: PART XII

writing component.[15] Three of these six semester hours must be at upper-division level. Courses used to satisfy the writing requirement may be used simultaneously to satisfy other requirements.

2. Psychology 317 or Educational Psychology 371; and three semester hours of mathematics other than Mathematics 301, 302, 303F, 316K, or 316L. Algebra courses at the level of Mathematics 301 or the equivalent cannot be counted toward the total hours required for the degree. Students who enter the University with fewer than three units of high-school mathematics at the level of Algebra I or higher must take Mathematics 301 or 304E without degree credit in order to remove their deficiency.

3. Chemistry 313N, 314N; Zoology 311K or six semester hours of biological sciences including Biology 302; Zoology 316K.

4. Six semester hours of American government; six semester hours of American history; three semester hours of sociology or cultural anthropology; three semester hours of psychology.

5. Forty-three semester hours in education including Curriculum and Instruction 632E, 370E (*Readings in Early Childhood*), 370E (*Mathematics in Early Childhood*), 371 (*Language Acquisition*), 371 (*Early Child Education*), 667C,[16] 667E,[16] 667K,[16] Educational Psychology 332E, 162; Special Education 371.

6. Not less than thirty-nine but not more than forty-eight semester hours of home economics including Home Economics 202K, 102L, 304, 311, 322, 333, 133L, 348 (*Art and Science*), 348 (*Music and Literature*), 366, 372K, 378K (*Theories of Child Development*), plus three additional hours from the area of child development and family relationships. Five hours of specified education will substitute for five of the thirty-nine hours required in home economics. Eighteen semester hours of home economics must be completed in residence at The University of Texas at Austin. (See "Course Numbers" in the General Information bulletin.)

7. Six hours of multicultural studies are required for certification. These hours may be satisfied by selecting courses from the English, history, or government requirements which are approved for multicultural studies. (Students should consult their adviser for a list of approved courses.)

8. Three semester hours chosen from art, drama, music, classics, architecture, or philosophy (other than logic).

9. Enough other courses to make a total of 126 semester hours.

10. Students who enter the University with fewer than two high-school units in a single foreign language must take the first two semesters in a language without degree credit to remove their language deficiency.

B. Special Requirements and General Limitations

The student must make a grade-point average of at least 2.0 for all courses completed at The University of Texas at Austin (including credit by examination, correspondence, and extension) for which a grade or symbol other than *Q, W,* or *CR* is recorded. In addition, he or she must make a grade of at least *C* on each course used to fulfill Requirement 6 above. A grade-point average of 2.35 is a prerequisite for Home Economics 348, 366, 372K, and Curriculum and Instruction 667K.

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[15] To determine whether a course has been certified as having a substantial writing component, consult the office of the Dean of the college in which the course is offered.

[16] Application for student teaching must be made in Educational Building 216 by May 1 of the year preceding enrollment in this course.

C. Order and Choice of Work

The student should consult with the faculty adviser each semester regarding order and choice of work.

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BACHELOR OF SCIENCE IN MATHEMATICS

As an alternative to the Bachelor of Arts degree, the Bachelor of Science in Mathematics degree is designed with a twofold purpose: (1) to offer students a more extensive scientific program that may better prepare them for graduate study or employment, and (2) to recognize students who meet these standards. Students are given the opportunity to develop greater breadth and depth in their mathematical programs as well as to combine mathematics with a concentration in another scientific discipline.

To accomplish this both the minimum hours of mathematics required and the maximum allowed are increased by nine hours. Specialization in one additional scientific area is encouraged, and the foreign language requirement, while shortened by one semester, specifies that the language be selected from among the scientific languages: French, German, or Russian. The total number of hours required is increased from 120 to 126.

A. Prescribed Work

1. English 306, 316K, and 346K. In addition to the English courses, a student must complete six semester hours in courses certified as having a substantial writing component.[17] Three of these six semester hours must be at upper-division level. Courses used to satisfy the writing requirement may be used simultaneously to satisfy other requirements.

2. Courses 406, 407, and three additional semester hours of French, German, or Russian (or such portion thereof as may be required by the score on the language test). For students who enter the University with fewer than two high-school units in a single foreign language, the first two semesters in a language will not count toward the 126 semester hours.

3. Six semester hours of American history.

4. Six semester hours of American government.

5. Three semester hours of anthropology, economics, geography, linguistics, psychology, or sociology.

6. Eight semester hours chosen from one of the following sciences or science combinations: astronomy, biology, botany, chemistry, geology, microbiology and biology, physics, zoology and biology.

7. Computer Sciences 304F (or 404G) or 304P (or 404) or the equivalent.

8. Six semester hours chosen from the following: architecture, classics, fine arts, philosophy, or programs of special concentration. Three of these six semester hours must be taken in architecture, classics, fine arts, or philosophy (other than logic).

9. Not less than forty-one but not more than forty-five semester hours of mathematics, including Mathematics 808 or the equivalent, 311, 427K or 370K, 362K, 665A, 373K, and at least twelve additional semester hours of upper-division courses in mathematics. All courses in mathematics must be passed with a minimum grade of *C*. Algebra courses at the level of Mathematics 301 or the equivalent cannot be counted toward the total hours

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[17] To determine whether a course has been certified as having a substantial writing component, consult the office of the Dean of the college in which the course is offered.

required for the degree. Students who enter the University with fewer than three units of high-school mathematics at the level of Algebra I or higher must take Mathematics 301 or 304E without degree credit in order to remove their deficiency.

10. Forty-two semester hours of upper-division courses. At least six upper-division hours must be taken in courses that are not mathematics courses and are not in the subject areas listed in Requirement 6.

11. Eighteen semester hours of mathematics must be completed in residence at The University of Texas at Austin.

12. Enough additional work to make a total of 126 semester hours.

B. Special Requirements

The student must (a) make a grade-point average of at least 2.0 for all courses completed at The University of Texas at Austin (including credit by examination, correspondence, and extension) for which a grade or symbol other than Q, W, or CR is recorded; in addition, he or she must (b) make a grade of at least C in each semester of each course in mathematics taken at The University of Texas at Austin and counted toward the major.

C. Order and Choice of Work

The following work is recommended as a typical program under the assumption that the student has the prerequisites for Mathematics 808A. Certain approved courses offered in the College of Business Administration may be substituted for economics. The science requirement may be fulfilled by approved courses in the College of Engineering. Additional courses that may be of interest to mathematics majors are offered by various departments in these colleges.

First Year: Mathematics 808; English 306; Courses 406 and 407 in a foreign language; three semester hours from Requirement 5 above; three semester hours from Requirement 8 above; six semester hours of electives.

Second Year: Mathematics 311, 427K, and three additional semester hours of mathematics; English 316K; third semester of foreign language; six semester hours of American history; Computer Sciences 304F (or 404G); six semester hours of electives.

Third Year: Mathematics 665A, 362K, and six additional semester hours of upper-division mathematics; eight semester hours of science from Requirement 6 above; six semester hours of American government; English 346K; three semester hours of upper-division elective.

Fourth Year: Mathematics 373K and nine additional semester hours of upper-division mathematics; three semester hours from Requirement 8 above; six semester hours of nonscience upper-division electives; six semester hours of additional upper-division electives; five semester hours of additional electives.

BACHELOR OF SCIENCE IN MEDICAL TECHNOLOGY

This degree is designed to enable the student preparing for medical technology simultaneously to earn the Bachelor of Science degree within the usual four-year period and to complete the technical training required for certification by the Registry of Medical Technologists. The purpose of this degree is to meet the increasing demands of the medical sciences for technologists with a higher level of science background and a greater degree of technical competence than that which can be attained by satisfying the minimum Registry requirements.

A. Prescribed Work

1. English 306, 316K, and 346K. In addition to the English courses, a student must complete six semester hours in courses certified as having a substantial writing component.[17] Three of these six semester hours must be at upper-division level. Courses used to satisfy the writing requirement may be used simultaneously to satisfy other requirements.

2. Courses 406 and 407 in a foreign language (or such portion thereof as may be required by the score on the language test). For students who enter the University with fewer than two high school units in a single foreign language, the first two semesters in a language will not count toward the 100 semester hours.

3. Six semester hours of American government.

4. Six semester hours of American history.

5. Three semester hours chosen from the following: Psychology 301 (recommended), Anthropology 302, economics, or sociology.

6. Three semester hours chosen from the following: art, drama, music, classics, architecture, or philosophy (other than logic).

7. Mathematics 305G or 808A. Algebra courses at the level of Mathematics 301 or the equivalent cannot be counted toward the total hours required for the degree. Students who enter the University with fewer than three units of high-school mathematics at the level of Algebra I or higher must take Mathematics 301 or 304E without degree credit in order to remove their deficiency.

8. Biology 302 and 303 or the equivalent.

9. Chemistry 301; 302; 204; 610 and 110K and 110L (or 618 and 118K and 118L); 412K; and 339K or 369.

10. Microbiology 329 and 129L (or 429) or 319 and 119K, 360, 160K, 361, 361K, and one course chosen from 330, 340, or 371.

11. Eight semester hours of physics chosen from one of the following sequences: Physics 327K and 127M (or 827A) and 327L and 127N (or 827B); or 302K, 302L, 102M, and 102N; or 301 and 101L and 316 and 116L; or 303K and 103M (or 403K) and 303L and 103N (or 403L).

12. Zoology 316K, 116L, 325, and three additional semester hours of upper-division biological sciences (Zoology 330 is recommended).

13. Such additional hours of electives as shall be required for a minimum total of one hundred semester hours of academic work prior to the fourth-year training program.

14. The satisfactory completion of twelve months of training in a school of medical technology accredited by the Board of Schools of the American Medical Association and the American Society for Clinical Pathology. A transcript of grades in all courses in the school of medical technology should be sent to the Office of the Dean, College of Natural Sciences, The University of Texas at Austin, Austin, Texas 78712, for approval, upon the recommendation of the faculty adviser of the Department of Microbiology. None of the work prescribed for the fourth year of this curriculum can be used to satisfy the minimum residence requirement.

B. Special Requirements

The student must make a grade-point average of at least 2.0 for all courses completed at

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[17] To determine whether a course has been certified as having a substantial writing component, consult the office of the Dean of the college in which the course is offered.

GRADUATION UNDER A PARTICULAR CATALOGUE

To receive a degree in the College of Natural Sciences, a student must fulfill all requirements for that degree as set forth in a catalogue under which the student is entitled to graduate. The student should understand, however, that there are several choices: (1) graduation under the current catalogue, (2) graduation under the catalogue in force the year the student first registered in The University of Texas at Austin (within the limitations stated in the second paragraph below), (3) graduation under the catalogue for any subsequent year in which the student was registered in the College of Natural Sciences or the College of Liberal Arts (again, within the limitations stated in the second paragraph below), (4) if registered in The University of Texas at Austin for the first time during a summer session, graduation under the catalogue governing the preceding long session or the one for the next long session, (5) if by March 1 of any year a student completes at least twelve semester hours in correspondence courses from The University of Texas at Austin, and if this work can be counted toward the degree, the student may graduate under the catalogue applying to that year, or (6) students who transfer to the College of Natural Sciences at The University of Texas at Austin from an accredited public Texas junior college may elect to use the catalogue in force at the time they first enrolled in junior college with the intent of being natural sciences majors.

All of these provisions are subject to the limitation that all requirements for a degree in the College of Natural Sciences must be completed within six years of the date of the catalogue chosen. If a student leaves school to enter military service in a period of emergency, the six-year period is exclusive of the time spent in the service.

GENERAL REQUIREMENTS

1. Degrees will be conferred only on dates publicly announced.
2. To receive a degree a student must be in residence[1] in the classroom at The University of Texas at Austin for at least two long-session semesters, or the equivalent period of residence, and must complete in residence in the classroom at least thirty semester hours counting toward the degree. For the B.A. degree, Plan I, these thirty hours must include at least eighteen semester hours in the major subject. For all degrees *other than* the B.A. degree, Plan I, these thirty semester hours must be in courses offered in arts and sciences and counting toward the degree.
3. Twenty-four of the last thirty semester hours offered for credit for an undergraduate degree must be completed in residence,[1] with the exception that among The University of Texas System components, a student may with the approval of the appropriate dean transfer additional course work to his program at the degree-granting institution. A student seeking an exception to this regulation must file at the degree-granting institution a written

petition with his academic dean, who may approve the transfer of additional credit. For the degree of Bachelor of Science in Medical Technology, this rule applies to the academic work.

4. At least six hours of advanced course work in the major field of study must be completed in residence.[1] Additional hours in the professional or major sequence in many cases are required by individual schools or colleges.
5. No credit earned by correspondence instruction from The University of Texas at Austin or elsewhere, and no credit earned by enrollment at another college or university or in Evening Classes in the Division of Continuing Education while the student is currently enrolled for residence work at The University of Texas at Austin, will be counted toward a degree in the College of Natural Sciences unless specifically approved in advance by the Dean of the College of Natural Sciences, or his representative. No more than thirty percent of the semester hours required for any degree offered in the College of Natural Sciences may be done by correspondence.
6. Undergraduate students who have received at least thirty semester hours of college credit shall be permitted to take not more than sixteen semester hours on a Pass-Fail basis to count toward their degree. They may not take more than two courses a semester on this basis. As a general rule, Pass-Fail courses are restricted to electives; for exceptions within the major, students should check with the department before registration.
7. Since the major subject is not shown on the diploma, it is not possible for a student to receive a second Bachelor of Arts degree from The University of Texas at Austin. No second bachelor's degree (Bachelor of Science in Physics, Bachelor of Science in Architectural Studies, etc.) will be conferred until the candidate has completed at least twenty-four semester hours in addition to those counted toward the bachelor's degree which requires the higher number of semester hours of credit.
8. Physical activity courses (PED 101–109C) may not be counted for degree credit in the Colleges of Natural Sciences and Liberal Arts. See "Physical Activity Courses," below.
9. An Air Force, Army, or Naval Reserve Officers Training Corps student who elects the basic and/or advanced program in air force science, military science, or naval science will not be approved for graduation until his Government contract is completed, unless he is released from the ROTC.
10. Nine semester hours of air force science, military science, or naval science courses may be counted for degree credit as free lower-division electives (in degree programs that have room for such electives) by students who complete the third and fourth years of the ROTC program (see p. 20).
11. No more than twelve semester hours of Bible may be counted toward a degree.
12. Music 200 cannot be counted toward any degree offered in the College of Natural Sciences. (Other preparatory courses, such as Music 200J, 200K, 201, may be counted toward degrees offered in the College of Natural Sciences.) Typewriting courses cannot be counted toward any degree in the College of Natural Sciences.

APPLYING FOR A DEGREE: THE DEGREE CHECK AND THE GRADUATION APPLICATION FORM

Upon the completion of sixty semester hours of credit the student must request a Degree Check in the Student Office, College of Natural Sciences. The Degree Check is prepared in the Dean's Office from the application and a copy of the student's record.
The student is then notified of the courses lacking and the requirements needed to

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[1] The term "in residence," is defined as in residence at the component institution of The University of Texas System which ultimately grants the degree. Residence credit does not include credit by examination or courses taken by extension or correspondence.

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188, 288, 388. *Marine Research Training Cruise.*

191, 391. *Seminar in Marine Studies.*

DEPARTMENT OF MATHEMATICS

Professor Daniel, Chairman

Professors Emeritus Craig,* Ettlinger, Greenwood, Lorentz, Nance, Prouse; *Professors* Armendariz, Berberian, Bernau, Bichteler, Bing, Bledsoe, Cannon, Carry, Casson, Charnes, Cheney, Daniel, Dollard, Durbin, Eaton, Edmondson, Gardner, Gibb, Gilbert, Gillman, Gordon, Guy, Hinkley, John, Kunen, McAdam, Morris, Oden, Osborn, Rosenthal, Showalter, Vick, Young; *Visiting Professors* Amir, Auslander, Beiglböck, Bombieri, Burkholder, Diamond, Franchetti, Glassey, Harville, Kunze, Prikry, Richter, Smoller, Swan, Ziegler; *Associate Professor Emeritus* Weaver; *Associate Professors* Cain, Friedman, Gerth, Goldfeld, Hamrick, Heitmann, Odell, Palka, Radin, Saltman, Schelter, Seever, Smith, Starbird, Tomas, Vaaler, Walston, Wise; *Visiting Associate Professors* Lichtman, Nicolo, Scharleman; *Adjunct Associate Professor* Lapidot; *Assistant Professors* Björnstad, Butler, Cantor, Graham, Kolesnik, Manevitz, Markowich, Miller, Mueller, Park, Shea, Szarek, Weissler, Williams; *Lecturers* Alladi, Beck, Chang, Ghoussoub, Goodrich, Groenewald, Heath-Brown, Lewis, Litherland, Megaw, Neveln, Rabier, Rubin.[10]

Lower-Division Courses

Most Mathematics Department courses enforce a specific minimum score (see a current Course Schedule or consult the Mathematics Department for details) on the College Board Achievement Test in Mathematics Level I as a prerequisite for taking the courses; thus, many students planning to enroll in Mathematics Department courses need to have taken the Mathematics Level I Test first. In addition to those students who need to have a specific minimum score as a prerequisite, all other students are required to present a score on the Mathematics Level I Test before registering for any lower-division course in the Mathematics Department, with the three following exceptions:

1) College of Engineering students who have college credit for calculus.
2) Nonengineering students who have either (a) completed a Mathematics Department course at The University of Texas at Austin with a passing grade, or (b) received credit by examination for a Mathematics Department course at the University, or (c) received Mathematics Department transfer credit at the University for a course taken elsewhere.
3) Graduate students who have received college credit elsewhere for a mathematics course that would be accepted by the University as transfer credit in the Mathematics Department.

Important advice on which entry-level Mathematics Department course to take—based on a student's Mathematics Level I Test score—is available from the Measurement and Evaluation Center and from the Mathematics Department. Each student for whom the

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* Deceased.
[10] This list, for the sessions 1981–1982 and 1982–1983, includes all staff members of professorial rank.

Mathematics Level I Test is required must present written proof of his or her test score before registering for a course in the Mathematics Department; in those courses for which there is a prerequisite minimum score (or course grade), students will be required in the first week of class to provide the instructor with written proof of their having satisfied the prerequisite. Students who took the test at a College Board test center must use the official College Board score report as such proof; such students who lack the score report can obtain alternate proof from the Measurement and Evaluation Center. Students who took the test on the University of Texas at Austin campus must use the test-result slip as the written proof; information about where to obtain the test-result slip will be given at the time of the test.

301. College Algebra.—May not be included in the major requirement for the Bachelor of Arts or Bachelor of Science degree with a major in mathematics. In some colleges, Mathematics 301 cannot be counted toward the Area C requirement or toward the total hours required for a degree. Credit for Mathematics 301 can NOT be earned after a student has received credit for any calculus course (Mathematics 808A, 608EA, or the equivalent) with a grade of at least *C*. Topics include a brief review of elementary algebra; linear, quadratic, exponential, and logarithmic functions; polynomials; systems of linear equations; applications. Prerequisite: Satisfactory score on the College Board Achievement Test in Mathematics Level I.

302. Introduction to Mathematics.—May not be included in the major requirement for the Bachelor of Arts or Bachelor of Science degree with a major in mathematics. May be repeated for credit when the topics vary. May be used to satisfy the Area C requirements for the Bachelor of Arts degree under Plan I or the mathematics requirement for the Bachelor of Arts degree under Plan II. Intended primarily for general liberal arts students. Designed to enable students to study the nature and techniques of mathematics. Topics include history and development of mathematical sciences, axiomatic mathematics, models and mathematics. Prerequisite: High-school mathematics skills.

603. Mathematics for Business and Economics.—Only one of the following may be counted: Mathematics 603B, 403K, 808, 608E. May not be included in the major requirement for the Bachelor of Arts or Bachelor of Science degree with a major in mathematics. First semester: logic, sets, permutations, combinations, probability, relations, functions, inequalities, introduction to linear programming, matrices. Second semester: linear programming, functions, analytic geometry, and calculus of elementary functions. Either half may be taken for independent credit. Prerequisite: For Mathematics 603A, a satisfactory score on the College Board Achievement Test in Mathematics Level I; for Mathematics 603B, a satisfactory score on the College Board Achievement Test in Mathematics Level I or Mathematics 603A with a grade of at least *C*.

303F. Mathematics of Investment.—May not be included in the major requirement for the Bachelor of Arts or Bachelor of Science degree with a major in mathematics. Simple and compound interest, equivalent rates, equivalent values, annuities, amortization, sinking funds, bonds, depreciation. Prerequisite: Satisfactory score on the College Board Achievement Test in Mathematics Level I.

403K. Mathematics for Business and Economics.—Only one of the following may be counted: Mathematics 403K, 603B, 808A, 608E. May not be included in the major requirements for the Bachelor of Arts or Bachelor of Science degree with a major in mathematics. Differential and integral calculus of algebraic, logarithmic, and exponential

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functions with applications; introduction to mathematics of finance. Prerequisite: Satisfactory score on the College Board Achievement Test in Mathematics Level I or Mathematics 301 with a grade of at least *B*, or a grade of at least *C* in Mathematics 304E or 305G. Three lectures and two discussion sessions a week for one semester. (Given for the first time in 1982–1983.)

304E. Trigonometry.—Mathematics 304E and 305G may not both be counted. Only one of the following may be included in the major requirement for the Bachelor of Arts or Bachelor of Science degree with a major in mathematics: Mathematics 304E, 305E, 305G. Credit for Mathematics 304E can NOT be earned after a student receives credit for any calculus course (Mathematics 808A, 608EA, or the equivalent) with a grade of at least *C*. Combines development of methods (including adequate treatment of theory) and acquisition of skills with applications. Prerequisite: Satisfactory score on the College Board Achievement Test in Mathematics Level I or Mathematics 301 with a grade of at least *B*.

305G. Elementary Functions and Coordinate Geometry.—Mathematics 305G and 304E may not both be counted. Only one of the following may be included in the major requirement for the Bachelor of Arts or Bachelor of Science degree with a major in mathematics: Mathematics 305G, 304E, 305E. Credit for Mathematics 305G can NOT be earned after a student receives credit for any calculus course (Mathematics 808A, 608EA, or the equivalent) with a grade of at least *C*. Study of elementary functions, their graphs and applications including polynomial, rational, and algebraic functions, exponential, logarithmic, and trigonometric functions. Prerequisite: Satisfactory score on the College Board Achievement Test in Mathematics Level I or Mathematics 301 with a grade of at least *B*.

407. Mathematics for Architects.—Open only to students who are candidates for the Bachelor of Architecture degree or the Bachelor of Science in Architectural Studies degree. A mathematics course specifically tailored for the architectural profession. Analytic geometry in two and three dimensions, including study of lines, planes, conic sections, second-degree surfaces, and parallel and central projections; mathematics of finance. Prerequisite: A knowledge of trigonometry and a satisfactory score on the College Board Achievement Test in Mathematics Level I, or Mathematics 304E or 305G or an equivalent course. Three lectures and two discussion sessions a week for one semester. (Given for the first time in 1981–1982.)

808. Calculus I and II.—Only one of the following may be counted: Mathematics 808, 603B, 403K, 608E. Introduction to the theory and applications of differential and integral calculus, including functions of several variables; topics will include the real numbers, functions, analytic geometry, limits, integrals, derivatives, mean value theorems, fundamental theorem of calculus, antiderivative techniques, areas, volumes, moments, arc length, problems involving maxima and minima, functions of several variables, series, trapezoidal and Simpson's rules. Certain sections are designated as intended primarily for well-prepared students of mathematics and mathematically-oriented sciences who wish to investigate more carefully the foundations of calculus. Either half may be taken for independent credit. Prerequisite: For 808A, four years of high-school mathematics and satisfactory score on the College Board Achievement Test in Mathematics Level I, or Mathematics 305G or 304E, either course with a grade of at least *C*; for 808B, Mathematics 808A with a grade of at least *C* or consent of instructor. Three lectures and two discussion sessions a week for two semesters.

608E. Calculus.—Only one of the following may be counted: Mathematics 608E, 603B, 403K, 808. Elements of differential and integral calculus with applications. Either half may be taken for independent credit. Prerequisite: For 608EA, four years of high-school mathematics and satisfactory score on the College Board Achievement Test in Mathematics Level I, or Mathematics 305G or 304E, either course with a grade of at least *C*; for 608EB, Mathematics 608EA with a grade of at least *C*. Three lectures a week for two semesters.

110, 210, 310, 410. Conference Course.—May be repeated for credit when the topics vary. Prerequisite: Consent of instructor. One, two, three, or four lectures a week for one semester.

311. Linear Algebra and Matrix Theory.—Mathematics 311 and 340L may not both be counted. Linear equations and matrices, linear mapping, determinants, eigenvalues, quadratic forms. Prerequisite: Mathematics 808 or consent of instructor.

316. Elementary Statistical Methods.—Only one of the following may be counted: Mathematics 316, 360K (when the topic is *Applications of Probability Theory*), 362K. May not be included in the major requirement for the Bachelor of Arts or Bachelor of Science degree with a major in mathematics. Graphical presentation, frequency functions, distribution functions, averages, standard deviation, variance, curve-fitting, and related topics.

316K. Modern Topics in Elementary Mathematics I.—Mathematics 316K and 360M may not both be counted. Enrollment restricted to prospective elementary teachers or to others whose degree programs specifically require it. May not be included in the major requirement for the Bachelor of Arts or the Bachelor of Science degree with a major in mathematics. Selected topics in number systems, with emphasis on the development of basic concepts in mathematical thinking needed for elementary teachers. Prerequisite: Consent of elementary education adviser or mathematics education adviser, and satisfactory score on the College Board Achievement Test in Mathematics Level I.

316L. Modern Topics in Elementary Mathematics II.—Mathematics 316L and 360N may not both be counted. Enrollment restricted to prospective elementary teachers or to others whose degree programs specifically require it. May not be included in the major requirement for the Bachelor of Arts or Bachelor of Science degree with a major in mathematics. Selected topics in mathematics, with emphasis on the development of basic concepts in mathematical thinking needed for elementary teachers. Prerequisite: Mathematics 316K.

318K. Calculus III.—Only one of the following may be counted: Mathematics 318K, 808B, 325. Together with Mathematics 608E, forms the equivalent of Mathematics 808. Prerequisite: Mathematics 608E with a grade of at least *C*.

318M. A Survey of Numerical Techniques.—Same as Computer Sciences 318. Only one of the following may be counted: Mathematics 318M, 348, Computer Sciences 318, 348. Introduction to numerical techniques for problems such as interpolation, approximation, numerical differentiation and integration, differential equations, zeros of functions, solution of linear systems. Prerequisite: At least eight hours of calculus and FORTRAN programming at the level of Computer Sciences 304F (or 404G) or 206, or consent of instructor.

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Upper-Division Courses

325. Calculus III.—Only one of the following may be counted: Mathematics 325, 808B, 318K. Continuation of Mathematics 608E. Prerequisite: Six hours of calculus with a grade of at least C or consent of instructor.

325K. Discrete Mathematics.—Same as Computer Sciences 325. Topics include logic, set theory, relations and functions, combinatorics, graph theory and graph algorithms, matrix operations, and elementary linear algebra. Prerequisite: Mathematics 808 and Computer Sciences 304F (or 404G) or 304P (or 404).

427K. Advanced Calculus for Applications I.—Infinite series, ordinary and partial differential equations. Prerequisite: Mathematics 808. Five sessions a week for one semester.

427L. Advanced Calculus for Applications II.—Matrices, elements of vector analysis and calculus of functions of several variables, including gradient, divergence, and curl of a vector field, multiple integrals and chain rules, length and area, line and surface integrals. Green's theorems in the plane and space, and if time permits, complex analysis. Prerequisite: Mathematics 808. Five sessions a week for one semester.

328K. First Course in the Theory of Numbers.—Mathematics 328K and 360K (when the topic is *Number Theory*) may not both be counted. Properties of the integers, divisibility, linear and quadratic forms, prime numbers, congruences and residues, quadratic reciprocity, number theoretic functions. Prerequisite: Mathematics 808 or the equivalent.

333L. Structure of Modern Geometry.—Basic ideas of plane and solid geometry; ruler and compass constructions; representation of space objects by plane projections; use of these ideas in teaching plane and solid geometry. Prerequisite: Mathematics 808, or upper-division standing and consent of instructor.

340L. Matrices and Matrix Calculations.—Mathematics 340L and 311 may not both be counted. Techniques of matrix calculations and applications of linear algebra. Prerequisite: One semester of calculus or consent of instructor.

343K. Introduction to Algebraic Structures.—Credit for Mathematics 343K can NOT be earned after a student has received credit for Mathematics 373K with a grade of at least C. Elementary properties of groups and rings, including symmetric groups, properties of the integers, polynomial rings, elementary field theory. Prerequisite: Mathematics 311 or consent of instructor.

350. Applied Linear Algebra.—Systems of equations, eigensystems, unitary and similarity transformations, linear programming, quadratic forms, and variational principals. Prerequisite: Mathematics 311 or consent of instructor.

360K. Topics in Modern Mathematics I.—May be repeated for credit when the topics vary. Designed especially for elementary education majors with mathematics concentration. May not be counted in fulfilling the major requirements for a bachelor's or master's degree in mathematics. Prerequisite: Mathematics 808A and 316L, or written consent of the mathematics education adviser.

Topic 1: *Applications of Probability Theory.* Only one of the following may be counted: Mathematics 360K.1, 316, 362K. A problem-oriented, problem-solving approach to an in-depth development of discrete probability theory and the normal distribution.

Topic 2: *Number Theory.* Mathematics 360K.2 and 328K may not both be counted. An investigative approach to classical number theory, closely paralleling its history, with emphasis on discovery and development.

[**360R. Topics in Mathematics for Advanced Business Administration and Economics.**—May not be counted in fulfilling the major requirements for a bachelor's or master's degree in mathematics. May be repeated for credit when the topics vary. Prerequisite: Six hours of college mathematics, upper-division standing, and consent of instructor.]

361. Theory of Functions of a Complex Variable.—Elementary theory and applications of analytic functions, series, contour integration, and conformal mappings. Prerequisite: Mathematics 427K or 665A, or upper-division standing and consent of instructor.

361K. Introduction to Analysis.—May not be taken by students with credit for Mathematics 665A. Topics include real numbers, convergence, infinite series, topology of the line. Prerequisite: Mathematics 808 or the equivalent.

362K. Probability I.—Only one of the following may be counted: Mathematics 362K, 316, 360K (when the topic is *Applications of Probability Theory*). An introductory course in the mathematical theory of probability; fundamental to further work in probability and statistics. Prerequisite: Mathematics 808 or the equivalent.

362L. Probability II.—Continuation of Mathematics 362K. Prerequisite: Mathematics 362K.

362M. Introduction to Stochastic Processes.—Introduction to Markov chains, birth and death processes, and other topics. Prerequisite: Mathematics 362K.

364K. Vector and Tensor Analysis I.—Invariance, vector algebra and calculus, integral theorems, general coordinates, introductory differential geometry and tensor analysis, applications. Prerequisite: Mathematics 427K or 427L.

364L. Vector and Tensor Analysis II.—Continuation of Mathematics 364K with emphasis on tensor and extensor analysis. Reimannian geometry, and invariance. Prerequisite: Mathematics 364K.

665. Introduction to Analysis.—Either half may be taken for independent credit. An introduction to basic concepts and techniques in analysis. The first semester bridges the gap between elementary calculus (808) and more advanced courses in analysis primarily by putting the elementary calculus of functions of one real variable on a rigorous foundation. Topics include axioms for the real numbers, elementary topology of the line, limits, continuity and differentiability, the intermediate value theorem and the mean value theorem, the Reimann integral, and the fundamental theorem of calculus for a continuous function on a closed interval. The second semester, which is a continuation of the first, includes topics in functions of several variables. Prerequisite: For 665A, Mathematics 808 and 311, or consent of instructor; for 665B, Mathematics 665A. Three lectures a week for two semesters.

367K. Topology I.—An introduction to topology, including sets, functions, cardinal numbers, and the topology of metric spaces. Prerequisite: Mathematics 311 or consent of instructor.

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367L. Topology II.—Various topics in topology, primarily of a geometric nature. Prerequisite: Mathematics 367K or consent of instructor.

368K. Numerical Mathematics for Applications.—Same as Computer Sciences 368K. Introduction to numerical methods for applied problems in science and engineering. Topics include linear equations, approximation, differential equations. Prerequisite: Mathematics 427K or the equivalent and FORTRAN programming at the level of Computer Sciences 304F (or 404 or 404G) or 206, or consent of instructor.

370K. Differential Equations I.—Discussion of existence, uniqueness, and qualitative properties of solutions; methods for representation of solutions. Prerequisite: Mathematics 427K or 665A or consent of instructor.

372. Fourier Series and Boundary Value Problems.—Discussion of differential equations of mathematical physics and representation of solutions by Green's functions and eigenfunction expansions. Prerequisite: Mathematics 427K or 370K.

373K. Algebraic Structures I.—A study of groups, rings, and fields, including structure theory of finite groups, isomorphism theorems, polynomial rings, and principal ideal domains. Prerequisite: Mathematics 311.

373L. Algebraic Structures II.—Topics from vector spaces and modules, including direct sum decompositions, dual spaces, canonical forms, and multilinear algebra. Prerequisite: Mathematics 373K.

374. Fourier and Laplace Transforms.—Operational properties and application of Laplace transforms, some properties of Fourier transforms. Prerequisite: Mathematics 427K.

374K. Fourier and Laplace Transforms.—Continuation of Mathematics 374. Introduction to other integral transforms such as Hankel, Laguerre, Mellin, Z, etc. Prerequisite: Mathematics 374.

175, 275, 375, 475. Conference Course.—May be repeated for credit when the topics vary. Prerequisite: Upper-division standing in mathematics and consent of instructor. One, two, three, or four lectures a week for one semester.

676. Methods of Applied Mathematics.—May be repeated for credit when the topics vary. A unified treatment of various methods of applied mathematics with discussion of linear spaces, spectral theory of operators, Green's functions, and elementary theory of distributions; the precise contents will depend on the interest of the instructor. Prerequisite: Mathematics 427K and 427L, or 665A. Three lectures a week for two semesters.

377K. Mathematics for the Life Sciences.—Topics in mathematics applied to problems in the biological sciences; probability, statistics, and differential equations. Prerequisite: Mathematics 808A or consent of instructor.

378K. Introduction to Mathematical Statistics.—Estimation of parameters and testing of hypotheses. Mathematics 378K and 362K form the core sequence for students in statistics. Prerequisite: Mathematics 362K.

378L. Introduction to Decision Theory.—Topics in estimation and hypothesis testing,

and an introduction to game theory from the decision theoretic viewpoint. Prerequisite: Mathematics 362K. (Not yet given.)

378M. Statistical Methods.—Analysis of variance, factorial experiments, and regression analysis; emphasis on applications. Prerequisite: Upper-division standing, an introductory statistics course, and consent of instructor.

378S. Statistics for Scientists.—Statistical methods with emphasis on the laboratory sciences. Topics include confidence intervals, hypothesis testing, analysis of variance, and regression. May not count toward the Bachelor of Arts or Bachelor of Science in Mathematics degrees without prior written approval of the undergraduate adviser in mathematics. Prerequisite: Upper-division or graduate standing in science and Mathematics 808 or the equivalent. (To be offered for the first time in 1983–1984.)

Graduate Courses

680C. Algebra.

681C. Real and Abstract Analysis.

381D. Complex Analysis.

681K. Analysis for the Applied Sciences.

682C. General Topology.

682D. Algebraic Topology.

382E. Differential Geometry.

383C. Numerical Analysis: Linear and Nonlinear Algebra.

383D. Numerical Analysis: Approximation, Quadrature, and Differential Equations.

684C. Theory of Probability.

684D. Mathematical Statistics.

684E. Analysis of Variance and Design of Experiments.

384F. Regression Analysis.

384G. Multivariate Statistical Analysis.

386K. Numerical Treatment of Differential Equations.

390C. Topics in Algebra.

391C. Topics in Analysis.

392C. Topics in Topology.

393C. Topics in Applied Mathematics.

393D. Topics in Numerical Analysis.

393N. Numerical Solution of Elliptic Partial Differential Equations.

394C. Topics in Probability and Statistics.