The Curriculum

REQUIREMENTS FOR THE BACHELOR OF ARTS DEGREE

No single course of study can be prescribed as essential for an educated man or woman. But Williams College has two categories of course requirements for all students. The Major Requirement is designed to assure that all Williams undergraduates will have the experience of disciplined and cumulative study, carried on over an extended period of time, in some important field of intellectual inquiry. The Distribution Requirement is intended to foster broadened awareness of some of the most important ways in which man has tried to understand himself, his artistic achievements, his relationships to others, and the nature of the physical world.

Required Number of Courses

Credit for thirty-two graded semester courses and four passed Winter Study Projects is required for the degree. In addition, four semesters of Physical Education must be completed by the end of the sophomore year.

Freshmen may enroll in only one course in any department during each semester of the first year. Sophomores may register for as many as two courses in any department upon petition to the Committee on Academic Standing.

The Major

Juniors are required to choose a major field of concentration. The selection is normally made at the time of registration in the spring of the sophomore year.

Major Fields

Majors are offered in the following fields:

- American Civilization
- Art
- Astronomy and Physics
- Biology
- Chemistry
- Classics
- Greek
- Latin
- History of Ideas
- Mathematics
- Music
- Philosophy
- Physics
- Political Economy
- Political Science
- Psychology

*Offered by the Department of History.
**Offered jointly by the Departments of Astronomy and Physics.
***Offered jointly by the Departments of Economics and Political Science.

General Structure

1. A student ordinarily must elect at least nine semester courses in his major field. The major may also require a tenth course and/or one Winter Study Project during the junior or senior year.

2. A prescribed sequence of courses, supplemented by parallel courses and ending in a senior major course, is required in some major fields. Other majors ask the student to plan a sequence of elective courses, including advanced work building on elementary courses in the field, and ending in a one or two semester faculty-organized course or project in the senior year. All fields of concentration provide a system of counseling to help students plan programs reflecting individual interests as well as disciplined and cumulative patterns of inquiry.

Courses in many major programs require prerequisite courses in related areas. A full description of the detailed structure of each major is found under the heading of that major in a section of the catalog, "Courses of Instruction."

Contract Major

A student completing a contract major (p. 76.) is also required to complete nine or ten semester courses, including a senior major course or seminar, and a senior major exercise.

Double Major

A student with a strong interest in two regular majors may double major with the permission of the major department or program and the Committee on Academic Standing.
Mathematics

Russian 301 Introduction to the Russian Classics in Translation
Russian 302 Introduction to Soviet Literature in Translation (Not offered 1975-76)
Russian 303 Dostoevsky in Translation (Not offered 1975-76; to be offered 1976-77.)
Russian 307 Tolstoy in Translation
Spanish 210 Post-Civil War Spain Through Its Novels

MATHEMATICS (Div. III)

DEPARTMENTAL STAFF FOR 1975-76

Chairman, Professor G. L. Spencer, II
Professor Spencer, Professor Oliver, Professor Jordan, Professor Kozerka, Professor Grarrow, Associate Professor Hill, Assistant Professor Roosenraad, Assistant Professor W. Green, L. Wright (Director of Computer Services).

MAJOR PROGRAM

Introductory courses:
Mathematics 107 Introduction to the Calculus or
Mathematics 109 Elementary Calculus
Mathematics 110 Infinite Series and Multivariable Calculus

Sequence courses:
Variation in the sequence courses, adapting the program within the general course requirements to special needs and interests of the individual student, may be arranged in consultation with the department.
Mathematics 201 Linear Algebra
Mathematics 301 Real Analysis
Mathematics 312 (formerly 317) Introduction to Abstract Algebra
Mathematics 406 Senior Major Course

Elective courses and projects:
Three one-semester courses from among Mathematics 241 and the 300 and 400 level non-sequence courses offered by the department.
Participation on the part of senior majors in the Senior Colloquium.

*On sabbatical leave second semester 1975-76

In addition it is recommended but not required that one Winter Study Project be taken during the junior or senior year.

The major program emphasizes analysis, provides an introduction to modern algebra, and gives an opportunity for exploration of individual interests in mathematics by choice of elective and Winter Study Project.

THE DEGREE WITH HONORS IN MATHEMATICS

The principal considerations in recommending a student for the degree with Honors will be: mastery of core material and skills; breadth and, particularly, depth of knowledge beyond the core material; ability to pursue independent study of mathematics with a minimum of direction; originality in methods of investigation; and, where appropriate, creativity in research.

When applying for candidacy for the degree with Honors at the beginning of the second semester of his Senior year, a student must present evidence of achievement in these areas. Normally, the minimum achievement would consist of participation in a mathematics seminar and in an independent reading course. The independent reading may be preparatory to writing a thesis.

The Mathematics Department urges all students who plan to be candidates for the degree with Honors to consult with the Department at the beginning of their Junior year. At that time, the Department will be prepared to suggest a Faculty Honors Adviser for each student, who will assist in planning the student's program with particular reference to his choice of seminar, independent reading course, and thesis topic (where applicable).

Every candidate for the degree with Honors will take an Honors examination at the end of his Senior year. Normally, this will be oral examination on an assigned topic.

Recommendations for the degree with Honors will be made for outstanding performance in the areas mentioned above; completion of an assigned program will not in itself be sufficient. Students who have, in the opinion of the Department, displayed exceptional ability, achievement, or originality will be recommended for the degree with Highest Honors.

ADVANCED PLACEMENT

The Mathematics Department attempts to place each student who elects a mathematics course in that course best suited to the student's preparation and goals. A freshman enrolling in Williams College is asked to complete a questionnaire with the help of the student's secondary school mathematics teacher, indicating the mathematical material covered by the student and the level of sophistication of the student's previous mathematical experience. The student is placed in the appropriate mathematics course determined by the results of the questionnaire, the results of the Ad-
vanced Placement Examination (AB or BC) if the student took one, and any additional available information. A student who receives a 4 or 5 on the BC examination and elects to continue the calculus is ordinarily placed in Mathematics 110 with credit given for Mathematics 107. A student who receives a 3 on the BC examination or a high grade on the AB examination and whose high school training indicates adequate preparation will receive credit for Mathematics 107 if he or she elects Mathematics 110 and completes it with a grade of C- or better. Students may elect Mathematics 140 in the fall term if they have had the equivalent of Mathematics 107 (or better) in high school. Pre-medical students with adequate background should consider electing Mathematics 110 and Mathematics 140 in either order. In any event, students registering for mathematics courses are urged to consult with members of the department concerning appropriate courses and placement. The department reserves the right to place students in that point of the calculus sequence which is appropriate to their previous preparation.

GENERAL REMARKS

Divisional Requirements
All courses listed may be used towards satisfying this requirement.

Alternate year courses
Mathematics 231, 241, 304, 306, 313, 315, 321, 324, 325, 330, 351, 352, 360 and 362, as well as Computer Science 331 and 332 are each normally offered once every two years. All other courses listed are normally offered every year.

Course Numbering
Courses numbered 200 and above are normally open to all students meeting the prerequisites. Students with questions about the level at which courses are conducted are invited to consult members of the department.

Courses open on a pass-fail basis
Students taking a mathematics course on a pass-fail basis must meet all the requirements set for students taking the course on a graded basis. With the permission of the department, any course offered by the department may be taken on a pass-fail basis. Permission will not be given to mathematics majors to meet any of the requirements of the major or honors degree on this basis. However, with the permission of the department, courses taken in the department beyond those requirements may be taken on a pass-fail basis.

Computer Language Instruction
Because of the increased importance of computers and their applications, all students are urged in their beginning courses in mathematics to learn the Basic programming language. The instruction is provided in a short series of non-credit lectures offered twice each semester, by the Department. At frequent intervals the Computer Laboratory offers all students a short non-credit lecture series concerning the operation and Fortran programming of the IBM 1130 computer.

Graduate School requirements
There are an increasing number of graduate and professional schools that require mathematics as a prerequisite to admission or to attaining their degree. Students interested in graduate or professional training in business, medicine, economics, or psychology are advised to find the requirements in those fields early in their college careers.

107, 107S Introduction to the Calculus
Functions, graphs, continuity. Derivatives and applications. Area and integration. Exponential, logarithmic and trigonometric functions.

Hours
107: A, C, D, RW
107S: B

Kozelka, Jordan

109 Elementary Calculus
A more advanced treatment of the material of Mathematics 107. Designed for students who have had an introduction to calculus in secondary school.

Hours A, C

110F, 110 Infinite Series and Multivariable Calculus
Continuation of Mathematics 107.

Sequences. Infinite Series. Techniques of multivariable calculus including partial derivatives, differentials, multiple integration, maximum and minimum problems and Lagrange multipliers.

Prerequisite, Mathematics 107 or 109.

Hours
110F: A, C, D, E
110: A, E

Hill, W. Green
Jordan, W. Green

111 Introduction to Linear Algebra
An introduction to linear algebra recommended for students interested in the social sciences. Topics include matrices, vectors, transformations, linear equations, determinants, and linear programming.

Provides sufficient background for Mathematics 351.

Credit will not be given for both Mathematics 111 and Mathematics 201.

Hour D

110F, 140 Calculus and Statistics
Elementary probability models, including continuous models derived from calculus considerations. Theory of statistical inference by integration and normal curve properties. The relationship between estimation and tests of hypotheses. Elementary multivariate probability: discrete and continuous and random variables.

Prerequisite, Mathematics 107.

Hours
140F: C
140: C, D Mon., Fri, Conferences: C, D, X, Y Wed.

Jordan
Kozelka
152 Combinatorics
A study of the properties of patterns and their enumeration. A variety of counting
 techniques will be developed and applications made to map coloring, network flow,
 the design of experiments, and problems in the physical and social sciences.
 Hour D

201, 201S Linear Algebra
Vector spaces, matrices, transformations.
Prerequisite, Mathematics 107 or 109.
Hours 201: B, E
201S: A

[203 Calculus Applications (Not offered 1975-76.)
Aimed at introducing the interested student in the Social Sciences to various cal-
culus techniques and applications. Topics will include differentiation, integration,
series, partial differentiation, differential equations, maxima and minima in several
variables, and Lagrange multipliers. Presented as a self paced instructional course.

Open to students who have not had Mathematics 107 or the equivalent.
Hour SPENCER

231 (formerly 230) Algorithms and Computing
An introduction to computing with emphasis on a systematic approach to the
problems normally encountered in computer applications. Intended for students
either needing good programming techniques in their own discipline, or wanting a
general introduction to computer science. Error analysis, systematic testing and
verification of programs, flow charting, methods of searching and sorting, elements of
structured programming, and general problem solving methods including simulation
and Monte Carlo methods. FORTRAN instruction is an integral part of the course.
Hour L

241 Intermediate Statistical Inference
Tests of statistical hypotheses, with emphasis on small-sample tests from normal
populations: t-test, F-test, chi square. Contingency tables and other non-parametric
tests. Introduction to utility theory. Applications directed towards the behavioral
sciences.
Prerequisite, Mathematics 140.
Hour T

301 Real Analysis
A systematic development of those aspects of elementary real analysis which form
the background for a wide range of mathematical activity. Elementary topology of
the real line, limits, continuity, differentiability, infinite series, uniform convergence,
the Riemann and Riemann-Stieltjes integrals.
Prerequisite, Mathematics 110 and 201.
Hour B

302 Complex Analysis
The complex number system, elementary functions and mappings, analytic func-
tions, Cauchy's integral theorem and its consequences, Taylor series and Laurent
series. Applications to the calculus of residues, conformal mapping, harmonic func-
tions and boundary value problems. Additional topics in the theory of analytic
functions.
Prerequisite, Mathematics 301.
Hour L

304 Integration and Measure Theory (Not offered 1975-76.)
The Lebesgue integral and Lebesgue measure on the real line. Additional topics
chosen from among the following: Lebesgue measure and integration in higher di-

dimensions, general measure theory, the Daniell integral, L_p spaces, probability theory.
Prerequisite, Mathematics 301.
Hour W. GREEN

306 Differential Equations
An introductory study of both ordinary and partial differential equations. Exist-
ence, uniqueness, properties of solutions, as well as consideration of methods of solution.
Prerequisite, Mathematics 301.
Hour C

312 (formerly 311) Introduction to Abstract Algebra
Groups, rings and fields.
Prerequisite, Mathematics 201.
Hour B

313 Elementary Number Theory (Not offered 1975-76.)
Divisibility properties of the integers: prime and composite numbers. Congruence
modulo n; solutions of linear and quadratic congruences and of some Diophantine
equations. The distribution of primes. Problems in additive arithmetic and dis-
cussion of some famous unsolved problems.
Prerequisite, Mathematics 201.
Hour T
Mathematics

315 Groups, Representations, and Characters
Group theory with emphasis on topics having applications in the physical sciences and with greater attention to examples than to proofs. Symmetry groups, group structure, representations and characters over the real and complex fields, space groups (chemistry), matrix groups (physics).
Prerequisite, Mathematics 201.
Hour E

321 Vector Analysis and Differential Geometry
A study of multivariable analysis leading into some elementary questions in differential geometry. Topics to be studied include: Inverse Function Theorem, Implicit Function Theorem, divergence, curl, the theory of curves, the theory of surfaces, differential forms, Stokes' Theorem and Green's Theorem.
Prerequisite, Mathematics 110 and 201.
Hour R

324 Topology
General spaces and the notions of continuity, connectedness, compactness. Metric spaces. Introduction to homology and homotopy.
Prerequisite, Mathematics 301.
Hour E

325 Topics in Geometry (Not offered 1975-76.)
Selected topics from projective geometry, geometric algebra, non-Euclidean geometry, Hilbert's axiomatic development of Euclidean geometry.
Prerequisite, Mathematics 201.
Hour E

330 Numerical Analysis (Not offered 1975-76.)
Solution of non-linear equations and linear systems, interpolation and approximation, numerical differentiation and integration, with attention to error analysis and efficiency of algorithms.
Prerequisite, Mathematics 201.
Hour E

Computer Science 331 Programming Languages (Not offered 1975-76.)
A study of the computer languages FORTRAN, BASIC, COBOL, ALGOL, LISP and APL. Concentration will be on the concepts of computer languages and comparisons between them, although students will be expected to write programs in each language studied.

Mathematics

371, 372, 471, 472 Topics in Actuarial Science
Directed independent study of topics in Actuarial Science aimed at preparing students for the examinations of the Society of Actuaries.
Prerequisite, permission of the instructor.
Hour

JORDAN

397, 398 Reading
Directed independent reading in Mathematics.
Prerequisite, permission of the department.

Hour

Members of the Department

403 Linear Analysis
Euclidean spaces and Fourier series; ordinary and partial differential operators; integral operators; boundary value problems.
Prerequisite, Mathematics 301.
Hour N

OLIVER

406 Senior Major Course
The purpose of the course is to emphasize the unity and power of mathematics by studying in depth a particular area of mathematics. The content will be chosen to draw as widely as possible upon the backgrounds of the participants and to illustrate a variety of applications. The exact topics to be covered will be decided by consultation among staff and students.

Senior course. Required of senior mathematics majors.
Prerequisite, permission of the department.
Hour S

OLIVER

407 Fall Seminar
Joint Faculty-student seminar. Topics selected in accordance with interests of the participants.
Prerequisite, permission of the department.
Hour M

OLIVER

491-492 Senior Thesis

407, 408 Reading
Directed independent reading in Mathematics.
Prerequisite, permission of the department.

Hour

Members of the Department

Music (Div. I)

William 1975

MUSIC (Div. I)

DEPARTMENTAL STAFF FOR 1975-76

Chairman, Professor I. Shainman

Professor Barlow, Professor Shainman, Professor Roberts, Assistant Professor Moore*, Assistant Professor Dankner, Lecturer Hegyi, Lecturer Beardsley**.

MAJOR PROGRAM

Sequence courses
Music 103 Introduction to Music, and any one of the following musical literature courses: Music 104F through 117.
Music 201-202 Elementary Harmony
Music 301-302 Music in History (Medieval and Renaissance Music in the first semester, plus a second semester of independent study as part of a "period" course, Music 210, 211, 212.)
Music 401-402 Twentieth Century Music

Parallel courses
An additional year course or two semester courses in Music. The student is especially encouraged to enroll in those courses which will develop his critical skills in analysis and creative work in music, including independent study with one or more members of the faculty (i.e., Music 303-304, 325, 326, 403-404 and 425, 426). It is expected that music majors will participate in at least one department sponsored performance group during their junior and senior years.

THE DEGREE WITH HONORS IN MUSIC

The degree with Honors in Music may be awarded to a student who has exhibited outstanding work in any one or more of the following areas:

*On leave second semester 1975-76
**Second semester 1975-76